Appendix B

Protocol for the LUMI-CELL® Estrogen Receptor (ER) Transcriptional Activation Test Method for the Detection of ER Agonists

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AGONIST PROTOCOL

LUMI-CELL® ESTROGEN RECEPTOR TRANSCRIPTIONAL ACTIVATION TEST METHOD FOR IDENTIFYING ESTROGEN AGONISTS AND ANTAGONISTS

National Toxicology Program (NTP) Interagency Center for the Evaluation of Alternative Toxicological Methods (NICEATM)

Developed by:
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LIST OF ACRONYMS AND ABBREVIATIONS

13 mm test tube	13 x 100 mm glass test tubes
Absolute EC_{50} value	Concentration of a substance that increases the measured activity in an agonist assay to 50% of the maximum activity induced by the reference substance
CASRN	Chemical Abstracts Service Registry Number
DMEM	Dulbecco's Modification of Eagle's Medium
DMSO	Dimethyl Sulfoxide
DMSO control	1% v/v dilution of DMSO in tissue culture media used as a vehicle control
E2	17β-estradiol
E2 reference standard	10 Point Serial Dilution of 17β-estradiol reference standard for the LUMI-CELL® ER agonist assay
EC_{50}	Concentration of test chemical causing half of maximal response
ER	Estrogen Receptor
Estrogen-free DMEM	DMEM (phenol red free) supplemented with 1% Penicillin/Streptomycin, 2% L-Glutamine, and 5% Charcoal-dextran treated FBS
FBS	Fetal Bovine Serum
G418	Gentamycin
GLP	Good Laboratory Practice
Methoxychlor	*p,p'*-Methoxychlor
Methoxychlor control	3.13 μg/mL Methoxychlor Positive Control for the LUMI-CELL® ER Agonist Assay
PBS	Phosphate-buffered Saline
Relative EC_{50} value	Concentration that produces a half-maximal response as calculated using the four parameter Hill function.
RLU	Relative Light Units
RPMI	RPMI 1640 growth medium
SMT	Study Management Team
SOP	Standard Operating Procedure
TA	Transcriptional Activation
T25	25 cm^2 tissue culture flask
T75	75 cm^2 tissue culture flask
T150	150 cm^2 tissue culture flask

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1.0 PURPOSE

This protocol is designed to evaluate coded test substances for potential estrogen receptor (ER) agonist activity using the LUMI-CELL® ER assay.

2.0 SPONSOR

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2.1 Substance Inventory and Distribution Management

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3.0 DEFINITIONS

- **Dosing Solution:** The test substance, control substance, or reference standard solution, which is to be placed into the tissue culture wells for experimentation.
- **Raw Data:** Raw data includes information that has been collected but not formatted or analyzed, and consists of the following:
    - Data recorded in the Study Notebook
    - Computer printout of initial luminometer data
    - Other data collected as part of GLP compliance, e.g.:
        - Equipment logs and calibration records
        - Test substance and tissue culture media preparation logs
        - Cryogenic freezer inventory logs
- **Soluble:** Test substance exists in a clear solution without visible cloudiness or precipitate.
- **Study Notebook:** The study notebook contains recordings of all activities related to the conduct of the LUMI-CELL® ER TA agonist assay.
- **Test Substances:** Substances supplied to the testing laboratories that are coded and distributed such that only the Project Officer, Study Management Team (SMT), and the Substance Inventory and Distribution Management have knowledge of their true identity. The test substances will be purchased, aliquoted, coded, and distributed by the Supplier under the guidance of the NIEHS/NTP Project Officer and the SMT.

4.0 TESTING FACILITY AND KEY PERSONNEL

4.1 Testing Facility

Xenobiotic Detection Systems, Inc. (XDS), 1601 E. Geer St., Suite S, Durham, NC 27704

4.2 Key Personnel

- Study Director: John Gordon, Ph.D.
- Laboratory Technician(s): Cynthia Matherly
- Scientific Advisor: Mike Denison, Ph.D.
- Quality Assurance Director: Andrew Chu
- Safety Manager: George Clark, Ph.D.

- Facility Management: George Clark, Ph.D., Robert Clark, Tina Ginter, Andrew Chu
- Laboratory Director: Andrew Chu

5.0 IDENTIFICATION OF TEST AND CONTROL SUBSTANCES

5.1 Test Substances

Test substances are coded and will be provided to participating laboratories by the Substance Inventory and Distribution Management team.

5.2 Controls

Controls for the ER agonist protocol are as follows:

Vehicle control (dimethyl sulfoxide [DMSO]): 1% (v/v) DMSO (CASRN 67-68-5) diluted in tissue culture media.

Reference standard (17β-estradiol [E2]): Three concentrations of E2 (CASRN 50-28-2) in duplicate for range finder testing and a serial dilution consisting of 10 concentrations of E2 in duplicate for comprehensive testing

Positive control (p,p'-Methoxychlor [methoxychlor]): Methoxychlor (CASRN 72-43-5), 3.13 μg/mL in tissue culture media, used as a weak positive control.

6.0 OVERVIEW OF GENERAL PROCEDURES FOR AGONIST TESTING

All experimental procedures are to be carried out under aseptic conditions and all solutions, glassware, plastic ware, pipettes, etc., shall be sterile. All methods and procedures shall be documented in the study notebook.

Agonist range finder testing is conducted on 96-well plates using three concentrations (1.00×10^{-4}, 2.00×10^{-6}, 1.00×10^{-7} μg/mL) of E2 in duplicate as the reference standard and six replicate wells for the DMSO control. Range finder testing uses all wells of the 96-well plate.

Comprehensive testing is conducted on 96-well plates using 10 concentrations of E2 in duplicate as the reference standard (**Table 6-1**). Four replicate wells for the DMSO control and three replicate wells for the methoxychlor control are included on each plate. To avoid edging effects[1], wells on the perimeter of the plate are not used for experiments. These wells should contain tissue culture media only.

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[1] Edging effects are variations in response seen in the outermost wells in a cell culture plate. These variations are believed to be due to variations in temperature, evaporation, etc., that may occur in these wells that would ultimately affect cellular growth and health (ICCVAM, 2001).

Table 6-1 Concentrations of E2 Reference Standard Used in Comprehensive Testing

E2 Concentrations[1]		
1.00×10^{-4}	6.25×10^{-6}	1.95×10^{-7}
5.00×10^{-5}	3.13×10^{-6}	9.78×10^{-8}
2.50×10^{-5}	1.56×10^{-6}	
1.25×10^{-5}	7.83×10^{-7}	

[1]Concentrations are presented in μg/mL.

Visual observations for cell viability are conducted for all experimental plates just prior to LUMI-CELL® ER evaluation. CellTiter-Glo® based cell viability testing (when used) is conducted concurrently in parallel plates, as outlined in **Section 11.2**.

Luminescence data, measured in relative light units (RLUs), is corrected for background luminescence by subtracting the mean RLU value of the vehicle control (DMSO) wells from the RLU measurements for each of the other wells of the 96-well plate. Data is then transferred into Excel® data management spreadsheets and GraphPad PRISM® 4.0 statistical software, graphed, and evaluated as follows:

- A response is considered positive for agonist activity when the average adjusted RLU for a given concentration is greater than the mean RLU value plus three times the standard deviation for the vehicle control.
- Any response below this threshold is considered negative for agonist activity.

For substances that are positive at one or more concentrations, the concentration that causes a half-maximal response (EC_{50}) is calculated using a Hill function analysis. The Hill function is a four-parameter logistic mathematical model relating the substance concentration to the response (typically following a sigmoidal curve) using the equation below:

$$Y = \text{Bottom} + \frac{\text{Top} - \text{Bottom}}{1 + 10^{(\log EC50 - X)\text{HillSlope}}}$$

where Y = response (i.e., relative light units); X = the logarithm of concentration; Bottom = the minimum response; Top = the maximum response; log EC_{50} = the logarithm of X as the response midway between Top and Bottom; and HillSlope describes the steepness of the curve. The model calculates the best fit for the Top, Bottom, HillSlope, and EC_{50} parameters. See **Section 11.6.5** for more details.

Acceptance or rejection of a test is based on evaluation of reference standard and control results from each experiment conducted on a 96-well plate. Results for these controls are compared to historical results compiled in the historical database, as seen in **Section 14.0**.

6.1 Range Finder Testing

Agonist range finding for coded substances consists of a six point, logarithmic serial dilution using duplicate wells per concentration. Concentrations for comprehensive testing are selected based on the response observed in range finder testing. If necessary, a second range finder test can be conducted to clarify the optimal concentration range to test (see **Section 12.0**).

6.2 Comprehensive Testing

Comprehensive agonist testing for coded substances consists of 11 point, double serial dilutions, with each concentration tested in triplicate wells of the 96-well plate. Three separate experiments are conducted for comprehensive testing on three separate days, except during Phases III and IV of the validation effort, in which comprehensive testing experiments are conducted once (see **Section 13.0**).

7.0 MATERIALS FOR LUMI-CELL® ER AGONIST TESTING

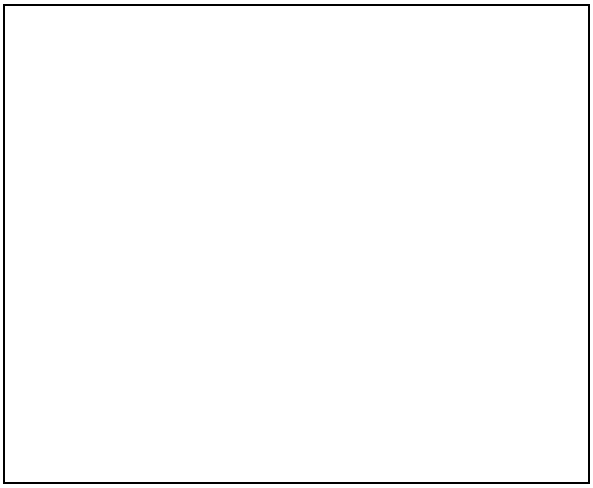
This section provides the materials needed to conduct LUMI-CELL® ER testing, with associated brand names/vendors[2] in brackets.

7.1 BG1Luc4E2 Cells:

Human ovarian cancer cell line stably transfected with a plasmid containing an estrogen response element pGudLuc7.0 (**Figure 7-1**) [XDS].

[2]Brand names and vendors should not be considered an endorsement by the U.S. Government or any member of the U.S. Government; such information is provided as examples.

Figure 7-1 pGudLuc7.ERE Plasmid.



7.2 Technical Equipment:

All technical equipment may be obtained from Fisher Scientific International, Inc. (Liberty Lane Hampton, NH, USA 03842). Equivalent technical equipment from another commercial source can be used.

- Analytical balance (Cat. No. 01-910-320)
- Berthold Orion 1 Microplate Luminometer [Berthold CatNo.: Orion 1 MPL3] or equivalent and dedicated computer
- Biological safety hood, class II, and stand (Cat. No. 16-108-99)
- Centrifuge (low speed, tabletop with swinging bucket rotor) (Cat. No. 04-978-50 centrifuge, and 05-103B rotor)
- Combustion test kit (CO_2 monitoring) (Cat. No. 10-884-1)
- Drummond diaphragm pipetter (Cat. No. 13-681-15)
- Freezers, –20°C (Cat. No. 13-986-150), and –70°C (Cat. No. 13-990-86)
- Hand tally counter (Cat. No. 07905-6)
- Hemocytometer, cell counter (Cat. No. 02-671-5)
- Light microscope, inverted (Cat. No. 12-561-INV)
- Light microscope, upright (Cat. No. 12-561-3M)
- Liquid nitrogen flask (Cat. No. 11-675-92)
- Micropipetter, repeating (Cat. No. 21-380-9)
- Pipetters, air displacement, single channel (0.5 –10µl (Cat. No. 21-377-191), 2 – 20 µl (Cat. No. 21-377-287), 20 – 200 µl (Cat. No. 21-377-298), 200 - 1000 µl (Cat. No. 21-377-195))

- Refrigerator/freezer (Cat. No. 13-986-106A)
- Shaker for 96-well plates (Cat. No. 14-271-9)
- Sodium hydroxide (Cat. No. 5318-500)
- Sonicating water bath (Cat. No. 15-335-30)
- Tissue culture incubator with CO_2 and temperature control (Cat. No. 11-689-4)
- Vacuum pump with liquid trap (side arm Erlenmeyer) (Cat. No. 01-092-29)
- Vortex mixer (Cat. No. 12-814)

Equipment should be maintained and calibrated as per GLP guidelines and individual laboratory SOPs.

7.3 Reference Standard, Controls, and Tissue Culture Supplies

All tissue culture reagents must be labeled to indicate source, identity, storage conditions and expiration dates. Tissue culture solutions must be labeled to indicate concentration, stability (where known), and preparation and expiration dates.

Equivalent tissue culture media and sera from another commercial source can be used, but must first be tested as described in **Section 15.0** to determine suitability for use in this test method.

The following are the necessary tissue culture reagents and possible commercial sources (in brackets) based on their use in the pre-validation studies:

- 17 β-estradiol (CAS RN: 50-28-2) [Sigma-Aldrich, Cat. No. E8875]
- CellTiter-Glo® Luminescent Cell Viability Assay [Promega Cat. No. G7572]
- Cryovial, 2 mL (Corning Costar) [Fisher Scientific Cat. No. 03-374-21]
- Culture tube 13 x 100mm (case) [Thomas Scientific Cat. No.: 10009186R38]
- Culture tube, 50 mL conical (Corning Costar) [Fisher Scientific Cat. No. 05-526C]
- DMSO, U.S.P. analytical grade. [Sigma-Aldrich, Cat. No. 34869-100ML]
- Dulbecco's Modification of Eagle's Medium (DMEM), containing 4.5 g/L glucose, with sodium pyruvate, without phenol red or L-glutamine [Mediatech/Cellgro, Cat. No. 17-205-CV]
- Fetal Bovine Serum [Mediatech/Cellgro Cat. No. MT 35-010-CV]
- Fetal Bovine Serum, charcoal/dextran treated, triple 0.1 μm sterile filtered [Hyclone, Cat. No. SH30068.03]
- Gentamycin Sulfate (G418), 50 mg/mL [Mediatech/Cellgro Cat. No. 30-234-CR]
- L-glutamine, 29.2 mg/mL [Cellgro, Cat. No. 25005-CI]

- Luciferase Assay System (10-Pack) [Promega Cat. No. E1501]
- Lysis Solution 5X [Promega, Cat. No. E1531]
- Methoxychlor (CAS RN: 72-43-5) [Sigma-Aldrich, Cat. No. 49054]
- Penicillin/streptomycin solution, 5000 I.U. penicillin, 5000 µg/mL streptomycin [Cellgro, Cat. No. 30-001-CI].
- Phosphate buffered saline (PBS, 1X) without calcium and magnesium [Cellgro, Cat. No. 21-040-CV]
- Pipettes, serological: 2.0 mL [Sigma-Aldrich, Cat. No. P1736], 5.0 mL [Sigma-Aldrich, Cat. No. P1986], 25 mL [Sigma-Aldrich, Cat. No. P2486]
- RPMI 1640 medium, containing L-glutamine [Mediatech, Cat. No. 10-040-CV]
- Tissue culture flasks (Corning-Costar): 25 cm^2 (T25) [Fisher Cat. No. 10-126-28]; 75 cm^2 (T75) [Fisher Cat. No. 10-126-37]; and 150 cm^2 (T150) [Fisher Cat. No. 10-126-34]
- Tissue culture plates (Corning-Costar): 96-well [Thomas Scientific Cat. No. 6916A05]
- Trypsin (10X), 2.5% in Hank's balanced salt solution (HBSS), without calcium and magnesium, without phenol red [Cellgro, Cat. No. 25-054-CI].

All reagent lot numbers and expiration dates must be recorded in the study notebook.

8.0 PREPARATION OF TISSUE CULTURE MEDIA AND SOLUTIONS

All tissue culture media and media supplements must be quality tested before use in experiment (see Section 15.0).

8.1 RPMI 1640 Growth Medium (RPMI)

RPMI 1640 is supplemented with 0.9% Pen-Strep and 8.0% FBS to make RPMI growth medium (RPMI).

Procedure for one 549 mL bottle:

1. Remove FBS from -70°C freezer, and Pen-Strep from -20°C freezer and allow to equilibrate to room temperature.
2. Add 44 mL of FBS and 5 mL Pen-Strep to the bottle of RPMI 1640.
3. Label RPMI bottle as indicated in **Section 7.3**

Store at 2-8°C for no longer than six months or until the shortest expiration date of any media component.

8.2 Estrogen-Free DMEM Medium

DMEM is supplemented to contain 4.5% charcoal/dextran treated FBS, 1.9% L-glutamine, 0.9% Pen-Strep.

Procedure for one 539 mL bottle:

1. Remove charcoal/dextran treated FBS from -70°C freezer, and L-glutamine and Pen-Strep from -20°C freezer and allow to equilibrate to room temperature.
2. Add 24 mL of charcoal/dextran treated FBS, 10 mL L-glutamine, and 5 mL Pen-Strep to one 500 mL bottle of DMEM.
3. Label estrogen-free DMEM bottle as indicated in **Section 7.3**

Store at 2-8°C for no longer than six months or until the shortest expiration date of any media component..

8.3 1X Trypsin Solution

1X trypsin solution is prepared by dilution from a 10X premixed stock solution. The 10X stock solution should be stored in 10 mL aliquots in a -20°C freezer.

Procedure for making 100 mL of 1X trypsin:

1. Remove a 10 mL aliquot of 10X trypsin from -20°C freezer and allow to equilibrate to room temperature.
2. Aliquot 1 mL trypsin (10X) along with 9 mL of 1X PBS into ten 15 mL sterile centrifuge tubes.
3. Label 1X trypsin aliquots as indicated in **Section 7.3**

1X Trypsin should be stored at -20°C.

8.4 1X Lysis Solution

Lysis solution is prepared by dilution from a 5X premixed stock solution. Both the 5X and 1X solutions can be repeatedly freeze-thawed.

The procedure for making 10 mL of 1X lysis solution:

1. Thaw the 5X Promega Lysis solution and allow it to reach room temperature.
2. Remove 2 mL of 5X solution and place it in a 15 mL conical centrifuge tube.
3. Add 8 mL of distilled, de-ionized water to the conical tube.
4. Cap and shake gently until solutions are mixed.

Store at -20°C for no longer than 1 year from receipt.

8.5 Reconstituted Luciferase Reagent

Luciferase reagent consists of two components, luciferase buffer and lyophilized luciferase substrate.

For long term storage, unopened containers of the luciferase buffer and lyophilized luciferase substrate can be stored at -70°C for up to one year.

To reconstitute luciferase reagent:

1. Remove luciferase buffer and luciferase substrate from -70°C freezer and allow them to equilibrate to room temperature.
2. Add 10 mL of luciferase buffer solution to luciferase substrate container and swirl or vortex gently to mix; the Luciferase substrate should readily go into solution.
3. After solutions are mixed, aliquot to a 15mL centrifuge tube.
4. Store complete solution at –20°C.

Reconstituted luciferase reagent is stable for up to 1 month at – 20°C.

8.6 Reconstituted CellTiter-Glo® Reagent

CellTiter-Glo® reagent consists of two components, CellTiter-Glo® buffer and lyophilized CellTiter-Glo® substrate.

For long term storage, unopened containers of the CellTiter-Glo® buffer and lyophilized CellTiter-Glo® substrate can be stored at -70°C for up to one year.

To reconstitute CellTiter-Glo® reagent:

1. Remove CellTiter-Glo® buffer and CellTiter-Glo® substrate from -70°C freezer and allow them to equilibrate to room temperature.
2. Add CellTiter-Glo® buffer solution to CellTiter-Glo® substrate container and swirl or vortex gently to mix; the CellTiter-Glo® substrate should readily go into solution.
3. After solutions are mixed aliquot to a 15mL centrifuge tube.
4. Store complete solution at –20°C.

Reconstituted CellTiter-Glo® reagent is stable for up to 3 months at – 20°C.

9.0 OVERVIEW OF PROPAGATION AND EXPERIMENTAL PLATING OF BG1Luc4E2 CELLS

The BG1Luc4E2 (BG-1) cells are stored in liquid nitrogen in 2 mL cryovials. BG-1 cells are grown as a monolayer in tissue culture flasks in a dedicated tissue culture incubator at 37ºC ±

1ºC, 90% ± 5% humidity, and 5.0% ± 1% CO_2/air. The cells should be examined, on a daily basis during working days, under an inverted phase contrast microscope and any changes in morphology and/or adhesive properties must be noted in the study notebook.

Two T150 flasks containing cells at 80 to 90% confluence will usually yield a sufficient number of cells to fill four 96-well plates for use in experiments.

9.1 Procedures for Thawing Cells and Establishing Tissue Cultures

Warm all of the tissue culture media and solutions to room temperature by placing them under the tissue culture hood several hours before use.

All tissue culture media, media supplements, and tissue culture plasticware must be quality tested before use in experiments (**Section 15.0**).

9.1.1 Thawing Cells

1. Remove a cryovial of frozen BG-1 cells from the liquid nitrogen flask.
2. Facilitate rapid thawing by loosening the top slightly (do not remove top) to release trapped gasses and retightening it. Roll vial between palms.
3. Use a micropipette to transfer cells to a 50 mL conical centrifuge tube.
4. Rinse cryovial twice with 1X PBS and add PBS rinse material to the conical tube.
5. Add 20 mL of RPMI to the conical tube.
6. Centrifuge at 1000 x *g* for eight min. If a pellet of cells has not formed, centrifuge for an additional 5 minutes.
7. Aspirate media from pellet and re-suspend it in 5 mL RPMI, drawing the pellet repeatedly through a 1.0 mL serological pipette to break up any clumps of cells.
8. Transfer cells to a T25 flask, place them in an incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).

9.1.2 Establishing Tissue Cultures

Once cells have reached 80 to 90% confluence, transfer the cells to a T75 flask by performing, for example, the following steps:

1. Remove the T25 flask from the incubator.
2. Aspirate the RPMI, then add 5 mL 1X PBS, making sure that the cells are coated with PBS.
3. Aspirate 1X PBS, then add 1 to 2 mL 1X trypsin to the T25 flask, gently swirling the flask to coat all cells with the trypsin.
4. Place the flask in an incubator (see conditions in **Section 9.0**) for 5 to 10 min.

5. Detach cells by hitting the side of the flask sharply against the palm or heel of the hand.
6. Confirm cell detachment by examination under an inverted microscope. If cells have not detached, return the flask to the incubator for an additional 2 minutes, then hit the flask again.
7. After cells have detached, add 5 mL PBS, and transfer the suspended cells to a 50 mL centrifuge tube. Wash the flask one additional time with 5 mL PBS.
8. Immediately add 20 mL RPMI to the conical tube to inhibit further cellular digestion by residual trypsin.
9. Pellet the cells by centrifugation, as described in **Section 9.1.1**, and re-suspend the cells in 10 mL RPMI medium.
10. Draw the pellet repeatedly through a 25 mL serological pipette to break up clumps of cells.
11. Transfer cells to a T75 flask, then place the flask in an incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).

When cells have reached 80% to 90% confluence, transfer them into a T150 flask by performing, for example, the following steps:

12. Remove the T75 flask from the incubator, aspirate the old media and add 5 mL 1X PBS.
13. Aspirate 1X PBS, add 2 mL of 1X trypsin to the flask, and place it in an incubator (see conditions in **Section 9.0**) for 5 to 10 min.
14. Repeat steps **5** through **11** in **Section 9.1.2,** re-suspending the pellet in 20 mL of RPMI.
15. Transfer cells to a T150 flask and place it in the incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).
16. Remove the T150 flask from the incubator.
17. Aspirate the RPMI and add 5 mL 1X PBS.
18. Aspirate 1X PBS and add 3 mL 1X trypsin to the T150 flask, making sure that the cells are coated with the trypsin.
19. Incubate cells in an incubator (see conditions in **Section 9.0**) for 5 to 10 min.
20. Detach cells by hitting the side of the flask sharply against the palm or heel of the hand.

21. Confirm cell detachment by examination under an inverted microscope. If cells have not detached, return the flask to the incubator for an additional 2 minutes, then hit the flask again.
22. After cells have detached, add 5 mL 1X PBS and transfer the suspended cells from the T150 flask to a 50 mL conical tube. Add an additional 5 mL PBS to the flask, swirl around the flask, and then transfer the PBS to the 50 mL conical tube.
23. Immediately add 20 mL RPMI to the conical tube to inhibit further cellular digestion by residual trypsin.
24. Centrifuge at 1000 x *g* for eight min. If a pellet of cells has not formed, centrifuge for an additional 5 minutes.
25. Aspirate the media from the pellet and re-suspend it in 40 mL RPMI, drawing the pellet repeatedly through a 25 mL serological pipette to break up any clumps of cells.
26. Transfer 20 mL of cell suspension to each of two T150 flasks, place them in an incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).

9.2 Ongoing Tissue Culture Maintenance, Conditioning in Estrogen-free Medium, and Plating Cells for Experimentation

The following procedure is used to condition the BG1Luc4E2 cells to an estrogen-free environment prior to plating the cells in 96-well plates for analysis of estrogen dependent induction of luciferase activity.

To start the tissue culture maintenance and estrogen-free conditioning, split the two T150 culture flasks into four T150 flasks. Two of these flasks will be used for continuing tissue culture and will use the RPMI media mentioned above. The other two flasks will be cultured in estrogen-free DMEM for experimental use. Extra care must be taken to avoid contaminating the estrogen-free cells with RPMI.

1. Remove both T150 flasks from the incubator.
2. Aspirate the medium and rinse the cells with 5 mL 1X PBS.
3. Aspirate 1X PBS, then add 3 mL 1X trypsin to the flasks, gently swirling the flask to coat all cells with the trypsin.
4. Incubate cells in the incubator (see conditions in **Section 9.0**) for 5 to 10 min.
5. Detach cells by hitting the side of the flask sharply against the palm or heel of the hand.

6. Confirm cell detachment by examination under an inverted microscope. If cells have not detached, return the flask to the incubator for an additional 2 minutes, then hit the flask again.
7. After cells have detached, add 5 mL 1X PBS to the first T150 flask and transfer the suspended cells to the second T150 flask.
8. Transfer the contents of both flasks to a 50 mL conical tube. Repeat step 7 with an additional 5 mL 1X PBS and transfer to the 50 mL conical tube.
9. Immediately add 20 mL estrogen-free DMEM to the 50 mL conical tube to inhibit further cellular digestion by residual trypsin.
10. Centrifuge at 1000 x *g* for eight min. If a pellet of cells has not formed, centrifuge for an additional 5 minutes.
11. Aspirate media from pellet and re-suspend it in 4 mL estrogen-free DMEM, drawing the pellet repeatedly through a 1 mL serological pipette to break up clumps of cells.

At this point, cells are ready to be divided into the ongoing tissue culture and estrogen-free conditioning groups.

9.2.1 Ongoing Tissue Culture Maintenance

1. Add 20 mL RPMI to two T150 flasks.
2. Add 220 µl G418 to the RPMI in the T150 flasks
3. Add 1 mL of cell suspension from **9.2** step **11** to each flask.
4. Place T150 flasks in tissue culture incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).
5. Tissue culture medium may need to be changed 24 hours after addition of G418 to remove cells that have died because they do not express reporter plasmid.
6. G418 does not need to be added to the flasks a second time.
7. Repeat **Section 9.2 steps 1-11** for ongoing tissue culture maintenance.

9.2.2 Conditioning in Estrogen-free Medium

1. Add 20 mL estrogen-free DMEM to two T150 flasks.
2. Add 150 µL G418 to the estrogen-free DMEM in the T150 flasks.
3. Add 1 mL of cell suspension from **Section 9.2 step 11** to each flask.
4. Tissue culture medium may need to be changed 24 hours after addition of G418 to remove cells that have died because they do not express reporter plasmid.
5. G418 does not need to be added to the flasks a second time.

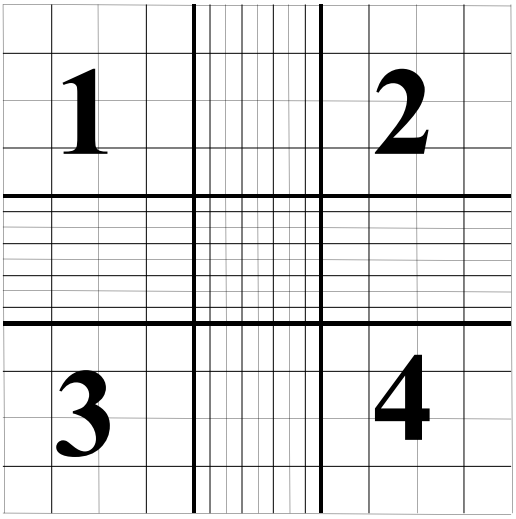
6. Place the T150 flasks in the incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).

9.2.3 Plating Cells Grown in Estrogen-free DMEM for Experimentation

1. Remove the T150 flasks that have been conditioned in estrogen-free DMEM for 48 to 72 hours from the incubator.
2. Aspirate the medium, then rinse the cells with 5 mL 1X PBS.
3. Aspirate 1X PBS, then add 3 mL 1X trypsin to the flasks, gently swirling the flask to coat all cells with the trypsin.
4. Place the flasks in an incubator (see conditions in **Section 9.0**) for 5 to 10 min.
5. Detach cells by hitting the side of the flask sharply against the palm or the heel of the hand.
6. Confirm cell detachment by examination under an inverted microscope. If cells have not detached, return the flask to the incubator for 2 additional minutes, then hit the flask again.
7. After cells have detached, add 5 mL 1X PBS and transfer the suspended cells from the T150 flask to a 50 mL conical tube. Add an additional 5 mL PBS to the flask, gently swirl around the flask, and then transfer to the 50 mL conical tube.
8. Immediately add 20 mL estrogen-free DMEM to each conical tube to inhibit further cellular digestion by residual trypsin.
9. Centrifuge at 1000 x *g* for eight min. If a pellet of cells has not formed, centrifuge for an additional 5 minutes.
10. Aspirate the media from the pellet and re-suspend it in 20 mL DMEM, drawing the pellet repeatedly through a 25 mL serological pipette to break up any clumps of cells.
11. Pipette 15 μL of the cell suspension into the "v" shaped slot on the hemocytometer. Ensure that the solution covers the entire surface area of the hemocytometer grid, and allow cells to settle before counting.
12. Using 100x magnification, view the counting grid.
13. The counting grid on the hemocytometer consists of nine sections, four of which are counted (upper left, upper right, lower left, and lower right, see **Figure 9-1).** Each section counted consists of four by four grids. Starting at the top left and moving clockwise, count all cells in each of the four by four grids. Some cells will be touching the outside borders of the square, but only count those that touch

the top and right borders of the square. This value is then used in the calculation below to get to the desired concentration of 200,000 cells/mL.

Figure 9-1 Hemocytometer Counting Grid.



The volume of each square is 10^{-4} mL, therefore:
Cells/mL=(average number per grid) x 10^{-4} mL x 1/(starting dilution).
Starting dilution: 20 mL (for T150 flasks)

Harvested cells for a T150 flask are suspended in 20 mL of estrogen-free DMEM and sampled for determination of concentration of cells/mL.

Example Calculation:

- Grids 1, 2, 3, and 4 are counted and provide the following data:
  - 50, 51, 49, and 50: average number of cells per grid is equal to 50.

Cells/mL = 50 cells per grid ÷ 10^{-4} mL volume of grid = 50 X 10^{4} cells/mL (or 500,000 cells/mL)

Total # of Cells Harvested = 500,000 cells/mL x 20 mL

Desired Concentration (or Concentration $_{Final}$)= 200,000 cells/mL

Formula: (Concentration $_{Final}$ x Volume $_{Final}$ = Concentration $_{Initial}$ x Volume $_{Initial}$)

Concentration $_{Final}$ = 200,000 cells/mL

Concentration $_{Initial}$ = 500,000 cells/mL

Volume $_{Initial}$ = 20 mL

Volume $_{Final}$ – to be solved for.

Therefore: 200,000 cells/mL x Volume $_{Final}$ = 500,000 cells/mL x 20 mL

Solving for Volume $_{Final}$ we find = 50 mL

Therefore, add 30 mL of estrogen-free DMEM to the cell suspension for a total volume of 50 mL, which will yield the desired concentration of 200,000 cells/mL for plating.

14. This dilution scheme will give a concentration of 200,000 cells/mL. 200 μL of this cell suspension is used for each well of a 96-well plate (i.e., 40,000 cells per well).
15. Remove a 96-well plate from its sterile packaging. Use a repeater pipetter to pipette:
    - 200 μL of cell suspension into each well for range finder testing
    - 200 μL of cell suspension into each well except the outside ring of wells for comprehensive testing and add 200 μL of estrogen-free DMEM to the outside ring of wells
16. Incubate plate(s) in an incubator (see conditions in **Section 9.0**) for a minimum of 24 hours, but no longer than 48 hours before dosing.

Two T150 flasks containing cells at 80% to 90% confluence will typically yield sufficient cells to fill four 96-well plates (not including the perimeter wells).

10.0 PREPARATION OF TEST SUBSTANCES

The solvent used for dissolution of test substances is 100% DMSO. All test substances should be allowed to equilibrate to room temperature before being dissolved and diluted. Test substance solutions (except for reference standards and controls) should not be prepared in bulk for use in subsequent tests. Test substances are to be used within 24 hours of preparation. Solutions should not have noticeable precipitate or cloudiness.

All information on weighing, solubility testing, and calculation of final concentrations for test substances, reference standards and controls is to be recorded in the study notebook.

10.1 Determination of Test Substance Solubility

1. Prepare a 100 mg/mL solution of the test substance in 100% DMSO in a 4 mL conical tube.
2. Vortex to mix.
3. If the test substance does not dissolve at 100 mg/mL, prepare a 10 mg/mL solution and vortex as above.
4. If the test substance does not dissolve at 10 mg/mL solution, prepare a 1 mg/mL solution in a 4 mL conical tube and vortex as above.
5. If the test substance does not dissolve at 1 mg/mL, prepare a 0.1 mg/mL solution in a 4 mL conical tube and vortex as above.
6. Continue testing, using 1/10 less substance in each subsequent attempt until test substance is solubilized in DMSO.

Once the test substance has fully dissolved in 100% DMSO, the solubility of the test substance must be determined in the 1% DMSO/99% estrogen-free DMEM mixture used for LUMI-CELL® ER testing.

7. Add 4 μL of the highest concentration of the test substance/DMSO solution to a 13 mm test tube.
8. Add 400 μL estrogen-free DMEM to the test tube and vortex gently,
9. If cloudiness or precipitate develop, vortex for up to 10 minutes.
10. If test substance has visible precipitate or is cloudy return to **10.1 step 7** to try the next lower concentration for the test substance.

The Testing Facility shall forward the results from the solubility tests assay to the SMT through the designated contacts in electronic format and hard copy upon completion of testing.

10.2 Preparation of Reference Standards, Control and Test Substances

All "dosing solutions" of test substance concentrations are to be expressed as *μg/mL* in the study notebook and in all laboratory reports.

All information on preparation of test substances, reference standards and controls is to be recorded in the study notebook.

10.2.1 Preparation of Reference Standard and Positive Control Stock Solutions

Stock solutions of E2 and methoxychlor are prepared in 100% DMSO and stored at room temperature for up to three years or until the expiration date listed in the certificate of analysis for that substance.

10.2.1.1 *E2 Stock Solution*

The final concentration of the E2 stock solution is 1.0×10^{-2} μg/mL. Prepare the E2 stock as shown in **Table 10-1**.

Table 10-1 Preparation of E2 Stock Solution

Step #	Action	DMSO	E2 Concentration
1	Make a 10 mg/mL stock solution in 100% DMSO in a 4mL vial.	-	10 mg/mL
2	Transfer 10 μL E2 solution from Step #1 to a new 4 mL vial.	Add 990 μL of 100% DMSO. Vortex to mix.	100 μg/mL
3	Transfer 10 μL E2 solution from Step #2 to a new 4mL vial.	Add 990 μL of 100% DMSO. Vortex to mix.	1 μg/mL
4	Transfer 10 μL E2 solution from Step #3 to a 13 mm test tube to create the working solution.	Add 990 μL of 100% DMSO. Vortex to mix.	0.1 μg/mL

10.2.1.2 *Methoxychlor Stock Solution*

The final concentration of the methoxychlor stock solution is 313 μg/mL.

To prepare the methoxychlor stock solution, proceed as follows:

1. Make a 10 mg/mL stock solution of Methoxychlor in 100% DMSO in a 4 mL vial.
2. Remove 94 μL of the methoxychlor solution and place it in a new 4 mL vial.
3. Add 2.906 mL of 100% DMSO to the 4mL vial and gently vortex to mix.

10.2.2 Preparation of Reference Standard and Positive Control Dosing Solutions for Range Finder Testing

Range finder testing is conducted on 96-well plates using three concentrations of E2 in duplicate as the reference standard. Six replicate wells are used for the DMSO control. All wells on the 96 well plate are used during range finder testing.

Store dosing solutions at room temperature. Use within 24 hours of preparation.

10.2.2.1 *Preparation of E2 Reference Standard Dosing Solutions for Range Finder Testing*

In preparation for making E2 dosing solutions, label two sets of three glass 13 mm test tubes with the numbers one through three and place them in a test tube rack. Tube number 1 will contain the highest concentration of E2 (**Table 10-2**).

Table 10-2 Preparation of E2 Reference Standard Dosing Solution for Range Finder Testing

Tube Number	E2	Estrogen-free DMEM[1]	Final Volume	Final E2 Concentration
1	4 µl of 1.0 x 10^{-2} µg/mL working solution	400 µL	404 µL	1.00 x 10^{-3}µg/mL
2	8 µL of 1.0 x 10^{-3} µg/mL from Tube #1	400 µL	408 µL	2.00 x 10^{-5}µg/mL
3	1 µL of 1.0 x 10^{-3} µg/mL from Tube#1	4000 µL	4001 µL	1.00 x 10^{-6}µg/mL

[1]Vortex all tubes to mix media and E2.

10.2.2.2 *Preparation of DMSO Control Dosing Solution for Range Finder Testing*

1. Add 4 µL of 100% DMSO to six 13 mm tubes (solvent/negative controls).
2. Add 400 µL of estrogen-free DMEM to each tube and vortex vigorously.

10.2.3 Preparation of Test Substance Dosing Solutions for Range Finder Testing

Range finder experiments are used to determine the concentrations of test substance to be used during comprehensive testing. Agonist range finding for coded substances consists of six point, logarithmic serial dilutions run in duplicate.

Label two sets of six glass 13 mm test tubes with the numbers 1 through 6 and place them in a test tube rack. Tube number 1 will contain the highest concentration of test substance (**Table 10-3**).

Table 10-3 Preparation of Test Substance Dosing Solutions for Range Finder Testing

Tube Number	100% DMSO	Test Substance[1]	Transfer[2]	Estrogen-free DMEM[3]	Final Volume
1	-	4 µL of test substance solution from **Section 10.1** step **14**	4 µL	400 µL	404 µL
2	90 µL	10 µL of test substance solution from **Section 10.1** step **14**	4 µL	400 µL	404 µL
3	90 µL	10 µL from Tube #2	4 µL	400 µL	404 µL
4	90 µL	10 µL from Tube #3	4 µL	400 µL	404 µL
5	90 µL	10 µL from Tube #4	4 µL	400 µL	404 µL
6	90 µL	10 µL from Tube #5	4 µL	400 µL	404 µL

[1]Vortex tubes #2 through 5 before removing test substance solution to place in the next tube in the series.
[2]Transfer test substance/DMSO solutions to a new set of 13 mm test tubes.
[3]Vortex all tubes to mix media and test substance solution.

Determination of whether a substance is positive in range finder testing and selection of starting concentrations for comprehensive testing will be discussed in **Section 12.0**.

10.2.4 Preparation of Reference Standard and Positive Control Dosing Solutions for Comprehensive Testing

Comprehensive testing is conducted on 96-well plates using 10 concentrations of E2 in duplicate as the reference standard. Four replicate wells for the DMSO control and three replicate wells for the methoxychlor control are included on each plate.

Store dosing solutions at room temperature. Use within 24 hours of preparation.

10.2.4.1 *Preparation of E2 Reference Standard Dosing Solutions for Comprehensive Testing*

In preparation for making E2 double serial dilutions, label two sets of 11 glass 13 mm test tubes with the numbers 1 through 11 and place them in a test tube rack. Tube number 1 will contain the highest concentration of E2 (**Table 10-4**).

Table 10-4 Preparation of E2 Reference Standard Dosing Solution for Comprehensive Testing

Tube Number	100% DMSO	E2[1]	Discard	Estrogen-free DMEM[2]	Final Volume
1	-	4 µL of 1.0 x 10^{-2} µg/mL working solution	-	400 µL	404 µL
2	4 µL	4 µL of 1.0 x 10^{-2} µg/mL stock solution	-	400 µL	404 µL
3	4 µL	4 µL from Tube #2	-	400 µL	404 µL
4	4 µL	4 µL from Tube #3	-	400 µL	404 µL
5	4 µL	4 µL from Tube #4	-	400 µL	404 µL
6	4 µL	4 µL from Tube #5	-	400 µL	404 µL
7	4 µL	4 µL from Tube #6	-	400 µL	404 µL
8	4 µL	4 µL from Tube #7	-	400 µL	404 µL
9	4 µL	4 µL from Tube #8	Discard Tube #9	-	-
10	4 µL	4 µL from Tube #9	-	400 µL	404 µL
11	4 µL	4 µL from Tube #10	Remove and discard 4 µL from Tube #11	400 µL	404 µL

[1]Vortex tubes #2 through 11 before removing E2 solution to place in the next tube in the series.
[2]Vortex all tubes to mix media and E2.

10.2.4.2 *Preparation of Methoxychlor Control Dosing Solution for Comprehensive Testing*

1. Add 4 µL of the 313 µg/mL methoxychlor to three separate 13 mm tubes.
2. Add 400 µL of estrogen-free DMEM to each tube and vortex vigorously.

10.2.4.3 *Preparation of DMSO Control Dosing Solution for Comprehensive Testing*

1. Add 4 µL of 100% DMSO to four 13 mm tubes (solvent/negative controls).
2. Add 400 µL of estrogen-free DMEM to each tube and vortex vigorously.

10.2.5 Preparation of Test Substance Dosing Solutions for Comprehensive Testing

Comprehensive testing experiments are used to determine whether a substance possesses ER agonist activity in the LUMI-CELL® ER test method. Agonist comprehensive testing for coded substances consists of 11 point, double serial dilutions, with each concentration tested in triplicate wells of the 96-well plate.

Start the 11-point serial dilution series at a single log dilution higher than the concentration giving the highest adjusted RLU value during the range finder (e.g., if the highest adjusted RLU value occurred at a concentration of 0.01 mg/mL, start the serial dilution at 0.1 mg/mL).

Label three sets of 11 glass 13 mm test tubes with numbers 1 through 11 and place them in a test tube rack. Tube number 1 will contain the highest concentration of test substance (**Table 10-5**).

Table 10-5 Preparation of Test Substance Dosing Solutions for Comprehensive Testing

Tube Number	100% DMSO	Test Substance[1]	Discard	Estrogen-free DMEM[2]	Final Volume
1	-	4 µL of highest concentration of test substance solution	-	400 µL	404 µL
2	4 µL	4 µL of highest concentration of test substance solution	-	400 µL	404 µL
3	4 µL	4 µL from Tube #2	-	400 µL	404 µL
4	4 µL	4 µL from Tube #3	-	400 µL	404 µL
5	4 µL	4 µL from Tube #4	-	400 µL	404 µL
6	4 µL	4 µL from Tube #5	-	400 µL	404 µL
7	4 µL	4 µL from Tube #6	-	400 µL	404 µL
8	4 µL	4 µL from Tube #7	-	400 µL	404 µL
9	4 µL	4 µL from Tube #8	-	400 µL	404 µL
10	4 µL	4 µL from Tube #9	-	400 µL	404 µL
11	4 µL	4 µL from Tube #10	4 µL	400 µL	404 µL

[1]Vortex tubes #2 through 11 before removing test substance solution to place in the next tube in the series.
[2]Vortex all tubes to mix media and test substance solution.

11.0 GENERAL PROCEDURES FOR THE TESTING OF CODED SUBSTANCES

Range finder experiments are used to determine the concentrations of test substance to be used during comprehensive testing. Comprehensive testing experiments are used to determine whether a substance possesses ER agonist activity in the LUMI-CELL® ER test method.

General procedures for range finder and comprehensive testing are nearly identical. For specific details (such as plate layout) of range finder testing see **Section 12.0**. For specific details of comprehensive testing, see **Section 13.0**.

11.1 Application of Reference Standard, Controls, and Test Substances

1. Remove the 96-well plates from the incubator, inspect them using an inverted microscope. Only use plates in which the cells in all wells receive a score of 1 according to **Table 11-1**.
2. Remove medium by inverting the plate onto blotter paper. Gently tap plate against the bench surface to remove residual liquid trapped in the wells.
3. Add 200 µL of medium, reference standard, control, or test substance to each well (see **Sections 12.0** and **13.0** for specific plate layouts).
4. Return plates to incubator and incubate (see **Section 9.0** for details) for 19 to 24 hours to allow maximal induction of luciferase activity in the cells.

11.1.1 Preparation of Excel® Data Analysis Template

1. In Excel®, open a new "AgICCVAMTemplate" and save it with the appropriate project name as indicated in the NICEATM Style Guide.
2. Add appropriate information regarding the assay to the "Compound Tracking" tab.
3. Enter substance testing information to the "List" page (i.e., Project /Sample ID, Concentration, and Comments [or compound name]). This should populate the "Template", "Compound Mixing" and "Visual Inspection" tabs with the appropriate information for the experiment.
4. Save the newly named project file.
5. Print out either the "List" or "Template" page for help with dosing the 96-well plate. Sign and date the print out and store in study notebook.

11.2 Visual Evaluation of Cell Viability

1. 19 to 24 hours after dosing the plate, remove the plate from the incubator and remove the media from the wells by inverting the plate onto blotter paper. Gently tap plate against the bench surface to remove residual liquid trapped in the wells.

2. Use a repeat pipetter to add 50 µL 1X PBS to all wells. Immediately remove PBS by inversion.
3. Using an inverted microscope, inspect all of the wells used in the 96-well plate and record the visual observations using the scores in **Table 11-1**.

Table 11-1 Visual Observation Scoring

Viability Score	Brief Description[1]
1	Normal Cell Morphology and Cell Density
2	Altered Cell Morphology and/or Small Gaps between Cells
3	Altered Cell Morphology and/or Large Gaps between Cells
4	Few (or no) Visible Cells
1P	Score of 1 with Precipitate
2P	Score of 2 with Precipitate
3P	Score of 3 with Precipitate
4P	Score of 4 with Precipitate
5P	Unable to View Cells Due to Precipitate

[1]Reference micrographs will be provided by NICEATM.

11.3 Lysis of Cells for LUMI-CELL® ER

1. Apply the reflective white backing tape to the bottom of the 96-well plate (this will increase the effectiveness of the luminometer).
2. Add 30 µL 1X lysis reagent to the assay wells and place the 96-well plate on an orbital shaker for one minute.
3. Remove plate from shaker and measure luminescence (described in **Section 11.5**).

11.4 CellTiter-Glo® Assessment of Cell Viability

When considered necessary, a quantitative evaluation of cell viability will be performed with the Promega CellTiter-Glo® assay system. CellTiter-Glo® uses luminescence as an indicator of the number of cells per plate and therefore must be conducted in parallel with the LUMI-CELL® ER test method (i.e., both test methods cannot be conducted on the same plate).

1. Dose and incubate cells under the same conditions as for LUMI-CELL® ER.
2. Remove plates from incubator and discard the medium by inverting the plate onto blotter paper. Gently tap plate against the bench surface to remove residual liquid trapped in the wells.
3. Use a repeat pipettor to add 50 µL 1X PBS to all assay wells. Immediately remove PBS by inversion.

4. Examine all wells used under an inverted microscope. Make notes of any well with codes described in **Table 11-1**.
5. Place white backing tape on the bottom of the 96-well plate.
6. Add 100 µL estrogen-free DMEM to each well containing cells.
7. Add 100 µL CellTiter-Glo® reagent to each well containing cells.
8. Place plate on an orbital shaker for 1 minute to induce cell lysis.
9. Incubate (see **Section 9.0** for details) for 10 min.
10. Measure luminescence promptly as in **Section 11.5**. Do *not* add luciferase reagent to CellTiter-Glo® plates.

11.5 Measurement of Luminescence

Luminescence is measured in the range of 300 to 650 nm, using an injecting luminometer and with software that controls the injection volume and measurement interval. Light emission from each well is expressed as RLU per well. The luminometer output is saved as raw data in an Excel® spread sheet. A hard copy of the luminometer raw data should be signed, dated and stored in the study notebook.

11.6 Data Analysis

LUMI-CELL® ER uses an Excel® spreadsheet to collect and adjust the RLU values obtained from the luminometer and a GraphPad PRISM® template to analyze and graph data. The Excel® spreadsheet subtracts background luminescence (average DMSO solvent control RLU value) from test substance, reference standard and control RLU values. Plate induction is calculated using these corrected RLU values. Test substance, reference standard, and control RLU values are then adjusted relative to the highest E2 reference standard RLU value, which is set to 10,000. After adjustment, values are transferred to GraphPad PRISM® for data analysis and graphing.

11.6.1 Correction and Adjustment of Luminometer Data

The following steps describe the procedures required to populate the Excel® spreadsheet that has been configured to collect and adjust the RLU values obtained from the luminometer.

1. Open the raw data file and the corresponding experimental Excel® spreadsheet from **Section 11.1.1**.
2. Copy the raw data using the Excel® copy function, then paste the copied data into cell C22 of the "RAW DATA" tab in the experimental Excel® spreadsheet using the Paste Special – Values command. This position corresponds to position B2 in the table labeled Table 1 in this tab.

3. Examine the DMSO data in Table 1 of the Excel® spreadsheet to determine whether there are any potential outliers. See **Section 11.6.2** for further explanation of outlier determinations.
4. If an outlier is identified, perform the following steps to remove the outlier from calculations:
    - correct the equation used to calculate DMSO background in Table 1 (e.g., if outlier is located in cell G24, adjust the calculation in cell H42 to read =AVERAGE(F24.H24,I24))
    - then correct the equation used to calculate the average DMSO value in Table 2 (e.g., following the above example, adjust cell M44 to read =AVERAGE(F36,H36,I36))
    - then correct the equation used to calculate the standard deviation of the DMSO value in Table 2 (e.g., following the above example, adjust cell M45 to read =STDEV(F36,H36,I36))
5. Excel® will automatically subtract the background (the average DMSO control value) from all of the RLU values in Table 1 and populate Table 2 with these adjusted values.
6. To calculate plate induction, identify the cell containing the E2 replicate that has the highest RLU value and the cell containing the RLU values for the same concentration in the corresponding E2 replicate (e.g., if the highest RLU value for E2 is located in cell E23, the corresponding cell would be E22).
7. Click into cell D16 and enter the cell number from the previous step into the numerator.
8. Click on the "ER Agonist Report" tab.
9. The data for the E2 reference standard, methoxychlor, and DMSO replicates populate the left portion (columns A – F) of the spreadsheet. The data is automatically placed in an Excel® graph.
10. To set the highest RLU value for the reference standard to 10,000 RLU, go to cell D2 of "ER Agonist Report" tab and check the formula contained within that cell. The divisor should be the cell number of the cell containing the highest averaged E2 RLU value (column E).
11. Use the forecast feature in Excel® to calculate an EC_{50}. To use forecast:
    - Calculate the midpoint by subtracting the lowest RLU from the highest and dividing by two.

- Forecast the EC50 value using the formula (FORECAST(x,known_y's,known_x's), where x = the data point for which you wish to predict a value [i.e., the median RLU], known y's = the three RLU values that constitute the middle of the linear portion of the concentration-response curve, and known x's = the concentrations corresponding to the known y's).

12. Copy the data into GraphPad PRISM® for graphing as indicated in the NICEATM PRISM® user's guide.

11.6.2 Determination of Outliers

The Study Director will use good statistical judgment for determining "unusable" wells that will be excluded from the data analysis and will provide an explanation in the study notebook for any excluded data. This judgment for data acceptance will include Q test analysis.

The formula for the Q test is:

$$\frac{Outlier - Nearest\ Neighbor}{Range\ (Highest - Lowest)}$$

where the outlier is the value proposed for exclusion, the nearest neighbor is the value closest to the outlier, and the range is the range of the three values (Q values for samples sizes from 3 to 10 are provided in Table 11-2). For example, if the value of this ratio is greater than 0.94 (the Q value for the 90% confidence interval for a sample size of three) or 0.76 (the Q value for the 90% confidence interval for a sample size of four), the outlier may be excluded from data analysis.

Table 11-2 Q Test Values

Number Of Observations	Q Value
2	-
3	0.94
4	0.76
5	0.64
6	0.56
7	0.51
8	0.47
9	0.44
10	0.41

For E2 reference standard replicates (sample size of two), any adjusted RLU value for a replicate at a given concentration of E2 is considered and outlier if its value is more than 20% above or below the adjusted RLU value for that concentration in the historical database.

11.6.3 Acceptance Criteria

Acceptance or rejection of a test is based on evaluation of reference standard and control results from each experiment conducted on a 96-well plate. Results are compared to quality controls (QC) for these parameters derived from the historical database, which are summarized below.

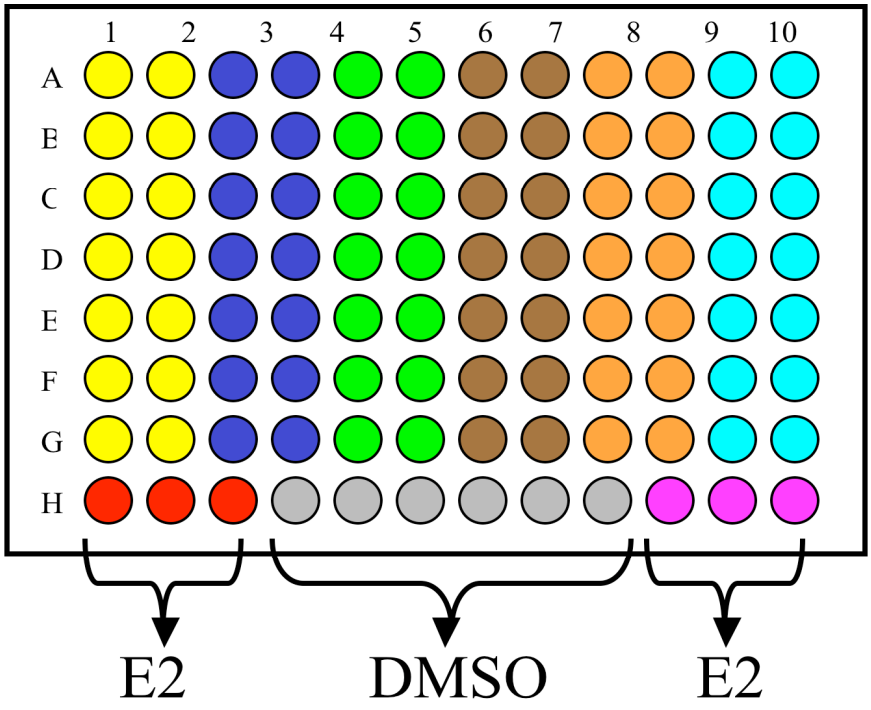
- Induction: Plate induction, as measured by dividing the averaged highest E2 reference standard RLU value by the averaged DMSO control RLU value, must be greater than three-fold.
- Reference standard results: Calculated E2 reference standard EC_{50} values must be within 2.5 times the standard deviation of the historical database EC_{50} mean value.
- Solvent control results: Solvent control RLU values must be within 2.5 times the standard deviation of the historical solvent control mean RLU value.
- Positive control results: Methoxychlor control RLU values must be within 2.5 times the standard deviation of the historical methoxychlor control mean RLU value.

An experiment that fails any single acceptance criterion will be discarded and repeated.

12.0 RANGE FINDER TESTING

Agonist range finding for coded substances consists of six-point, logarithmic serial dilutions, with each concentration tested in duplicate wells of the 96-well plate. **Figure 12-1** contains a template for the plate layout to be used in agonist range finder testing.

Figure 12-1 Agonist Range Finder Test Plate Layout



- Three Point E2 Reference Standard – Replicate 1

- Three Point E2 Reference Standard – Replicate 2

- DMSO Control (1% v/v)

- Range Finder for Sample #2

- Range Finder for Sample #1

- Range Finder for Sample #3

- Range Finder for Sample #4

- Range Finder for Sample #5

- Range Finder for Sample #6

Evaluate whether range finder experiments have met the acceptance criteria (see **Section 11.6.3**) and graph the data as described in the NICEATM PRISM® users guide.

To determine starting concentrations for comprehensive testing use the following criteria:

- If there are no points on the test substance concentration curve that are above the line representing the mean plus three times the standard deviation of the DMSO control, the highest concentration used in comprehensive testing is the limit dose or the maximum soluble dose.
- If there are points on the test substance concentration curve that are above the line representing the mean plus three times the standard deviation of the DMSO control, select a concentration that is a single log dilution higher than the concentration giving the highest adjusted RLU value in the range finder, and use that as the highest concentration for comprehensive testing.
- If a substance exhibits a biphasic concentration curve, the range finder experiment should be repeated unless the proposed concentration range for the comprehensive studies will include all concentrations of the biphasic region in the range finding study. If the range finder experiment is repeated and the substance still exhibits a biphasic concentration curve, comprehensive testing must be conducted on the peak of the biphasic curve at the lowest test substance concentration. If the substance is negative at this lowest concentration, then test at the higher concentration. For either peak of the concentration curve, select a concentration that is a single log dilution higher than the concentration giving the highest adjusted RLU value in the range finder and use that as the highest concentration for comprehensive testing.

13.0 COMPREHENSIVE TESTING

Agonist comprehensive testing for coded substances consists of 11-point, double serial dilutions, with each concentration tested in triplicate wells of the 96-well plate. **Figure 13-1** contains a template for the plate layout to be used in agonist comprehensive testing.

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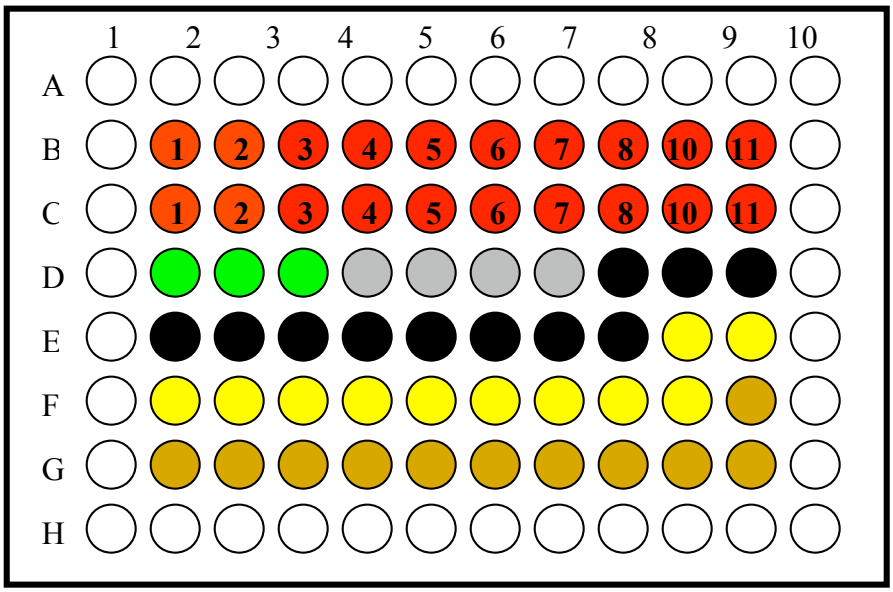


- E2 Reference Standard Dose Response Curve
Note: #9 in dilution series has been removed.

- Methoxychlor Control (3.13 µg/mL)

- DMSO Control (1% v/v)

- Comprehensive Dose Response Sample #1, Replicate #1

- Comprehensive Dose Response Sample #1, Replicate #2

- Comprehensive Dose Response Sample #1, Replicate #3

- Media only wells, not used for assay

1077

1078 Evaluate whether comprehensive experiments have met acceptance criteria (see **Section 11.6.4**)
1079 and graph the data as described in the NICEATM PRISM® users guide.

1080 • If the substance has been tested up to the limit dose or the maximum soluble dose,
1081 without causing a significant decrease in cell viability, and there are no points on
1082 the concentration curve that are above the line indicating the mean plus three
1083 times the standard deviation of the DMSO control, the substance is considered
1084 negative for agonism.

1085 • If the substance has a positive response (See **Section 6.0**) at any concentration,
1086 the substance is considered positive for agonism.

14.0 USE OF THE HISTORICAL DATABASE TO GENERATE QC CHARTS

The historical database is maintained in order to ensure that the test method is functioning properly. The historical database is maintained as an Excel® spreadsheet that is separate from the spreadsheets used to report the data for individual experiments. The controls used to develop the historical database are used as one of the criteria for determining a valid test.

Results collected during Phase I will be compared to historical control data established during the LUMI-CELL® ER Protocol Standardization Study. Reference standard and control data collected during Phase I will be used to compile the initial historical database. Reference standard and control data collected during Phase IIa will be added to the historical database compiled in Phase I, and this combined historical database will be used to establish acceptance criteria for Phase II. Reference standard and control data collected during Phase IIb will be added to the historical database compiled in Phases I and IIa and this combined historical database will be used to establish acceptance criteria for Phases III and IV.

14.1 LUMI-CELL® ER Agonist QC Charts

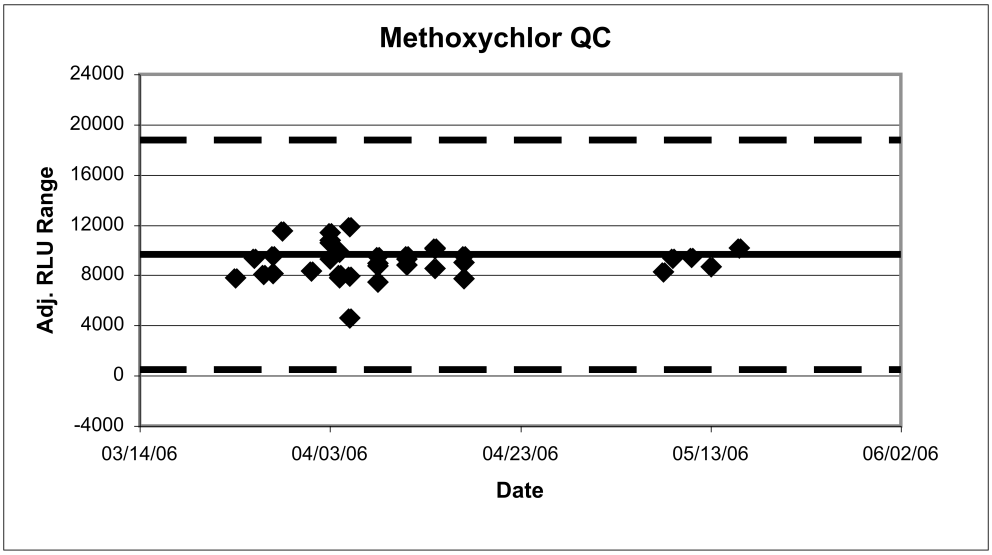
1. Open the Excel® spreadsheet labeled LUMIAgonistQC.
2. Save this sheet under a new name, adding the laboratory designator to the file name (e.g., for Laboratory A, the new name would be ALUMIAgonistQC).

14.1.1 Methoxychlor Control

1. Open the Excel® spreadsheet from **Section 14.1 step 2**.
2. Click on the methoxychlor tab and enter the date, plate number (name), and average 2.5 x 10^{-5} µg RLU value for E2 (data located in column F on the "List" tab of the agonist report file).
3. Enter the three values for methoxychlor into column D.
4. The mean and 2.5 times the standard deviation plus (and minus) the mean are calculated automatically.
5. Check the scatter charts tab to see if the average value for methoxychlor falls within the 2.5 times the standard deviation (**Figure 14-1)**. If the average value falls within the 2.5 times the standard deviation area, methoxychlor passes QC. If the average value falls outside of the 2.5 times the standard deviation area, methoxychlor fails QC and the experiment must be repeated.

Acceptance or rejection of the methoxychlor control data is based on whether the data for a given experiment falls within 2.5 times the standard deviation from the historical mean RLU value.

Figure 14-1 Example Scatter Chart of the Methoxychlor Control QC[1,2,3]



[1]Each point represents a single experiment.

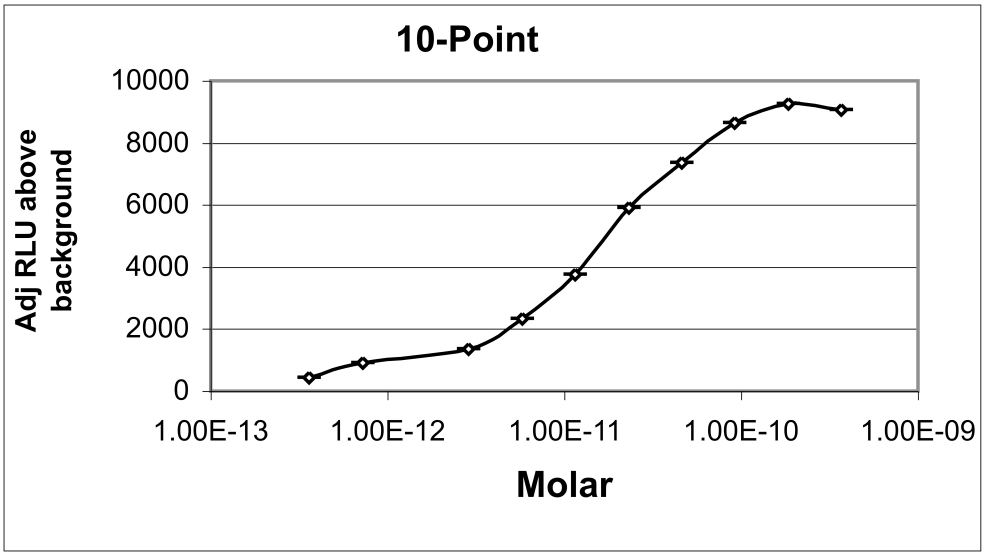
[2]The solid line represents the historical mean RLU value for the methoxychlor control.

[3]The two dashed lines represent the historical mean RLU value for the methoxychlor control plus and minus 2.5 times the standard deviation from the historical mean.

14.1.2 10-Point E2 Reference Standard QC

1. Enter the experiment date and name, and copy and paste the adjusted RLU values for E2 into the appropriate slots in the tab labeled E2 Standard Curve.
2. The E2 standard curve is automatically graphed to ensure a normal sigmoidal shape (see **Figure 14-2** for an example curve).

Figure 14-2 Example Figure of a Sigmoidal E2 Concentration Response Curve[1]

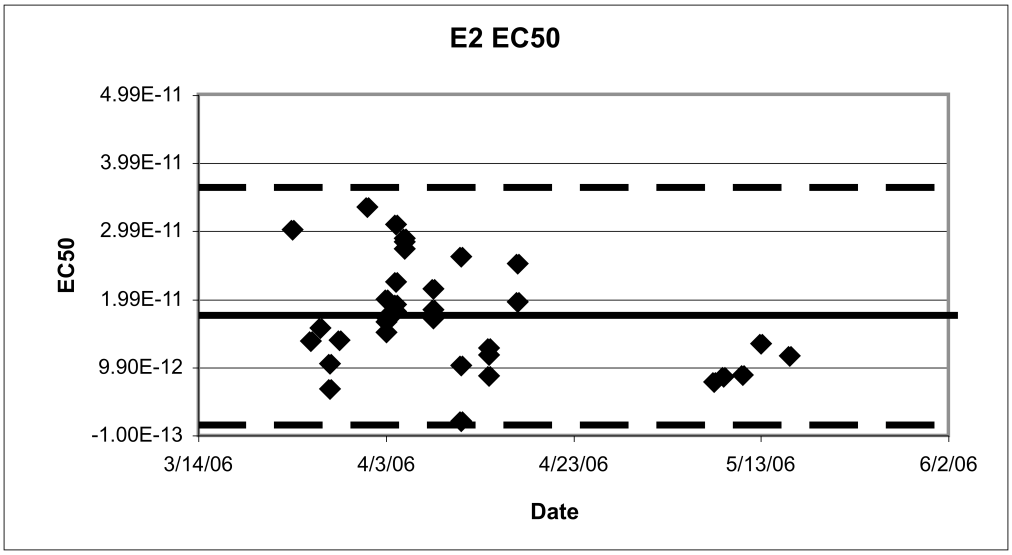


[1]The line represents the averaged E2 values for a single experiment.

14.1.3 EC_{50} Tracking Data

1. Enter the date and plate ID into the first two columns of the EC_{50} Tracking Data tab.
2. Link the EC_{50} data from the 10-point E2 Curve QC tab to the column to the right of the plate information.
3. Column E calculates the percent deviation from the historical database EC_{50} value.
4. The mean and 2.5 times the standard deviation plus (and minus) the mean for the EC_{50} deviation are calculated automatically.
5. Check the Scatter Charts tab to see whether the experimental EC_{50} value falls within the 2.5 times the standard deviation (**Figure 14-3**). If the value falls within the 2.5 times the standard deviation area, it passes QC. If the value does not fall within the 2.5 times the standard deviation, it fails QC and the experiment must be repeated.

Figure 14-3 Example Scatter Chart of the E2 EC_{50} Control QC[1,2,,3]



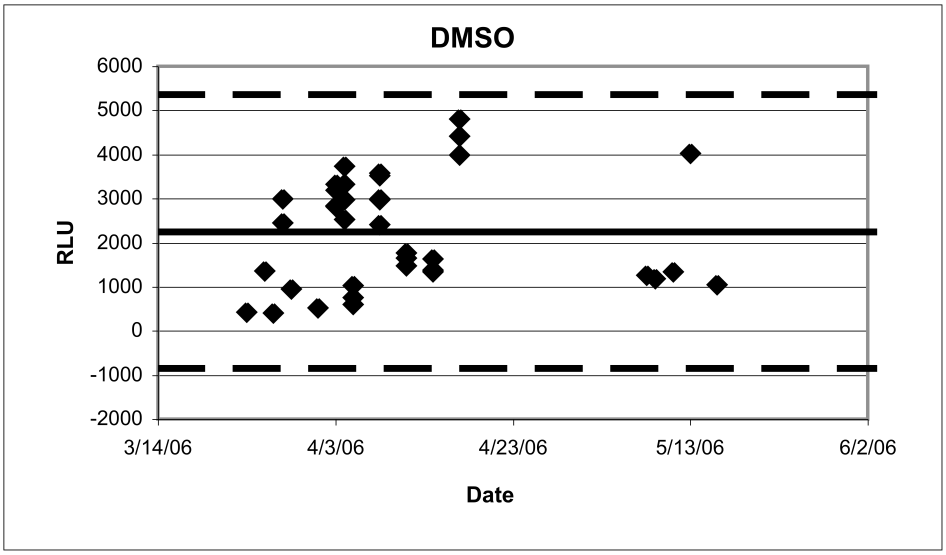
[1]Each point represents a single experiment.
[2]The solid line represents the historical mean RLU value for the E2 EC50.
[3]The two dashed lines represent the historical mean RLU value for the E2 EC50 control plus and minus 2.5 times the standard deviation from the historical mean.

Acceptance or rejection of E2 EC_{50} data is based on whether the data falls within 2.5 times the standard deviation from the mean for the historical E2 EC_{50} RLU value.

14.1.4 DMSO Control

1. The date and experiment name should populate automatically
2. Enter all of the DMSO values from Table 1 on the "Raw Data" tab on the Excel® spreadsheet which passed the outlier test, into the areas marked DMSO 1, DMSO 2, DMSO 3, and DMSO 4.
3. The average RLU value for DMSO is then calculated under the "mean" column.
4. The mean and 2.5 times the standard deviation plus (and minus) the mean for the DMSO deviation are calculated automatically.
5. Check the Scatter Charts tab to see whether the average value for DMSO falls within 2.5 times the standard deviation (**Figure 14-4**) from the mean. If the value falls within the 2.5 times the standard deviation area, the DMSO passes QC. If the value does not fall within the 2.5 times the standard deviation, it fails QC and the experiment must be repeated..

Figure 14-4 Example Scatter Chart of the DMSO Control QC[1,2,3]



[1]Each point represents a single experiment.
[2]The solid line represents the historical mean RLU value for the DMSO control.
[3]The two dashed lines represent the historical mean RLU value for the DMSO control plus and minus 2.5 times the standard deviation from the historical mean.

Acceptance or rejection of the DMSO control data is based on whether the data for a given experiment falls within 2.5 times the standard deviation from the historical mean RLU value.

14.1.5 Induction

Enter the induction value from the "Raw Data" tab on the Excel® spreadsheet. If the value is greater than or equal to 3, the experiment passed QC. An induction value of less than 3 fails induction QC and the experiment must be repeated.

15.0 QUALITY TESTING OF MATERIALS

All information pertaining to the preparation and testing of media, media supplements, and other materials should be recorded in the Study Notebook.

15.1 Tissue Culture Media

Each lot of tissue culture medium must be tested in a single growth flask of cells before use in ongoing tissue culture or experimentation (**note:** each bottle within a given lot of Charcoal/Dextran treated FBS must be tested separately).

1. Every new lot of media (RPMI and DMEM) and media components (FBS, Charcoal/Dextran treated FBS, and L-glutamine) must first be tested on the LUMI-CELL® ER assay prior to being used in any GLP acceptable assays.
2. Add 4 μL of DMSO (previously tested) into four separate 13 mm tubes.
3. Add 400 μL media (to be tested) to the same tubes.
4. Dose an experimental plate as in **Section 12.0,** treating the media being tested as a test substance.
5. Analyze 96-well plate as described in **Section 12.0,** comparing the data from the DMSO controls made using previously tested tissue culture media to the new media being tested.
6. Use the QC charts to determine if the new media with DMSO lies within 2.5 standard deviation of the mean for the media. If the RLU values for the new media with DMSO lie within 2.5 standard deviation of the mean for the historical data on DMSO, the new lot of media is acceptable. If the RLU values for the new media with DMSO do not lie within 2.5 standard deviation of the mean for the historical data the new lot may not be used in the assay.
7. Note date and lot number in study notebook.
8. If the new bottle passes the QC as described in **Section 15.1 step 6**, apply the media to a single flask cells and observe the cells growth and morphology over the following 2 – 3 days. If there is no change in growth or morphology, the new media is acceptable for use.

15.2 G418

1. New lots of G418 must first be tested on the LUMI-CELL® ER assay prior to being used in any GLP acceptable assays.
2. Add 220 μL of G418 (previously tested) to a single flask containing cells growing in RPMI.
3. Add 220 μL of G418 (to be tested) to a different flask containing cells growing in RPMI.
4. Observe cellular growth and morphology in both tissue culture flasks over a 48 to 72 hour period. If there are no differences in observed growth rate and morphology between the two flasks, the new G418 lot is acceptable.
5. If cellular growth is decreased, or the cells exhibit abnormal morphology, the new lot of G418 is not acceptable.
6. Note date and lot number in study book.

15.3 DMSO

1. Every new bottle of DMSO must be tested on the LUMI-CELL® ER assay prior to use in any GLP acceptable assays.
2. Add 4 μL of DMSO (to be tested) into four separate 13 mm tubes.
3. Add 400 μL media (previously tested) the same tubes.
4. Dose an experimental plate as in **Section 12.0,** treating the media being tested as a test substance.
5. Analyze 96-well plate as described in **Section 12.0,** comparing the data from the DMSO controls made using previously tested tissue culture media to the new media being tested.
6. Use the QC charts to determine if the new media with DMSO lies within 2.5 standard deviation of the mean for the media. If the RLU values for the new media with DMSO lie within 2.5 standard deviation of the mean for the historical data on DMSO, the new lot of media is acceptable. If the RLU values for the new media with DMSO do not lie within 2.5 standard deviation of the mean for the historical data the new lot may not be used in the assay.
7. Use the QC charts to determine if the new DMSO lies within 2.5 standard deviation of the mean for DMSO background. If the RLU for the new DMSO does lie within 2.5 standard deviation of the mean for the historical data on DMSO, then the new bottle of DMSO is acceptable; otherwise the new bottle may not be used in the assay.
8. Note the date, lot number, and bottle number in study book.
9. If no DMSO has been previously tested, test several bottles as described in **Section 15.3**, and determine whether any of the bottles of DMSO have a lower average RLU than the other bottle(s) tested. Use the DMSO with the lowest average RLU for official experiments.

15.4 Plastic Tissue Culture Materials

1. Grow one set of cells, plate them for experiments on plastic ware from the new lot and one set of cells in the plastic ware from a previous lot, and dose them with E2 reference standard and controls.
2. Perform the LUMI-CELL® ER experiment with both sets of cells.
3. If all of the analysis falls within acceptable QC criteria, then the new manufacturer's products may be used.

16.0 REFERENCES

ICCVAM. 2001. Guidance Document on Using *In Vitro* Data to Estimate *In Vivo* Starting Doses for Acute Toxicity. NIH Pub. No. 01-4500. Research Triangle Park, NC: National Institute of Environmental Health Sciences. Available: http://iccvam.niehs.nih.gov/methods/invidocs/guidance/iv_guide.pdf [accessed 31 August 2006]

Appendix C

Protocol for the LUMI-CELL® Estrogen Receptor (ER) Transcriptional Activation Test Method for the Detection of ER Antagonists

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ANTAGONIST PROTOCOL

LUMI-CELL® ESTROGEN RECEPTOR TRANSCRIPTIONAL ACTIVATION TEST METHOD FOR IDENTIFYING ESTROGEN AGONISTS AND ANTAGONISTS

National Toxicology Program (NTP) Interagency Center for the Evaluation of Alternative Toxicological Methods (NICEATM)

Developed by:

Xenobiotic Detection Systems, Inc.

1601 E. Geer St., Suite S

Durham, NC 27704

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LIST OF ACRONYMS AND ABBREVIATIONS

13 mm test tube	13 x 100 mm glass test tubes
Absolute IC_{50} Value	Concentration of a substance that decreases the measured activity in an antagonist assay to 50% of the maximum activity induced by the reference substance
CASRN	Chemical Abstracts Service Reference Number
DMEM	Dulbecco's Modification of Eagle's Medium
DMSO	Dimethyl Sulfoxide
DMSO Control	1% v/v dilution of DMSO in tissue culture media used as a vehicle control
E2	17β-estradiol
E2 Control	2.5×10^{-5} μg/mL E2 used as a control.
ER	Estrogen Receptor
Estrogen-free DMEM	DMEM (phenol red free), supplemented with 1 % Penicillin/Streptomycin, 2 % L-Glutamine, and 5% Charcoal-dextran treated FBS
FBS	Fetal Bovine Serum
Flavone/E2 Control	25 μg/mL flavone + 2.5×10^{-5} μg/mL E2, used as a positive control.
G418	Gentamycin
GLP	Good Laboratory Practice
PBS	Phosphate Buffered Saline
Ral/E2 Reference Standard	Nine point dilution of raloxifene HCl + 2.5×10^{-5} 17β-estradiol reference standard for the LUMI-CELL® ER antagonist assay
Relative IC_{50} Value	Concentration that produces a half-maximal response as calculated using the four parameter Hill function.
RLU	Relative Light Units
RPMI	RPMI 1640 growth medium
SMT	Study Management Team
SOP	Standard Operating Procedure
TA	Transcriptional Activation
T25	25 cm^2 tissue culture flask
T75	75 cm^2 tissue culture flask
T150	150 cm^2 tissue culture flask

LIST OF FIGURES

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LIST OF TABLES

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1.0 PURPOSE

This protocol is designed to evaluate coded test substances for potential estrogen receptor (ER) antagonist activity using the LUMI-CELL® ER assay.

2.0 SPONSOR

The National Toxicology Program (NTP) Interagency Center for the Evaluation of Alternative Toxicological Methods (NICEATM), P.O. Box 12233 Research Triangle Park, NC 27709

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2.1 Substance Inventory and Distribution Management

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Chemistry Resources Group Leader
National Institute of Environmental Health Sciences
MD EC-06, P.O. Box 12233
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Phone: 919-541-3473

3.0 DEFINITIONS

- **Dosing Solution:** The test substance, control substance, or reference standard solution which is to be placed into the tissue culture wells for experimentation.
- **Raw Data:** Raw data includes information that has been collected but not formatted or analyzed, and consists of the following:
    - Data recorded in the Study Notebook
    - Computer printout of initial luminometer data
    - Other data collected as part of GLP compliance, e.g.:
        - Equipment logs and calibration records
        - Test substance and tissue culture media preparation logs
        - Cryogenic freezer inventory logs
- **Soluble:** Test substance exists in a clear solution without visible cloudiness or precipitate.
- **Study Notebook:** The study notebook contains recordings of all activities related to the conduct of the LUMI-CELL® ER TA antagonist assay.
- **Test Substances:** Substances supplied to the testing laboratories that are coded and distributed such that only the Project Officer, Study Management Team (SMT), and the Substance Inventory and Distribution Management have knowledge of their true identity. The test substances will be purchased, aliquoted, coded, and distributed by the Supplier under the guidance of the NIEHS/NTP Project Officer and the SMT.

4.0 TESTING FACILITY AND KEY PERSONNEL

4.1 Testing Facility

Xenobiotic Detection Systems, Inc. (XDS), 1601 E. Geer St., Durham, NC 27704

4.2 Key Personnel

- Study Director: John Gordon, Ph.D.
- Laboratory Technician(s): Cynthia Matherly
- Scientific Advisor: Mike Denison, Ph.D.
- Quality Assurance Director: Andrew Chu
- Safety Manager: George Clark
- Facility Management: George Clark, Ph.D., Robert Clark, Tina Ginter

- Laboratory Director: Andrew Chu

5.0 IDENTIFICATION OF TEST AND CONTROL SUBSTANCES

5.1 Test Substances

Test substances are coded and will be provided to participating laboratories by the Substance Inventory and Distribution Management team.

5.2 Controls

Controls for the ER antagonist protocol are as follows:

Vehicle control (dimethyl sulfoxide [DMSO]): 1% v/v dilution of DMSO (CASRN 67-68-5) diluted in tissue culture media.

Ral/E2 reference standard for range finder testing: Three concentrations (1.25×10^{-1}, 1.25×10^{3}, and 5.00×10^{-5} μg/mL) of raloxifene HCl (raloxifene, CASRN 84449-90-1) plus a fixed concentration (2.5×10^{-5} μg/mL) of 17β-estradiol (E2, CASRN: 50-28-2).

Ral/E2 reference standard for comprehensive testing: A serial dilution of raloxifene HCl (raloxifene, CASRN 84449-90-1) plus a fixed concentration (2.5×10^{-5} μg/mL) of 17β-estradiol (E2, CASRN: 50-28-2), consisting of nine concentrations of Ral/E2 in duplicate wells.

E2 control: *17β-estradiol*, CASRN: 50-28-2, 2.5×10^{-5} μg/mL in tissue culture media used as a base line negative control.

Flavone/E2 Control: Flavone, CASRN 525-82-6, 25 μg/mL, with E2 2.5×10^{-5} μg/mL in tissue culture media used as a weak positive control.

6.0 OVERVIEW OF GENERAL PROCEDURES FOR ANTAGONIST TESTING

All experimental procedures are to be carried out under aseptic conditions and all solutions, glassware, plastic ware, pipettes, etc., shall be sterile. All methods and procedures shall be documented in the study notebook.

Antagonist range finder testing is conducted on 96-well plates using three concentrations of Ral/E2 (1.25×10^{-1}, 1.25×10^{-3}, and 5.00×10^{-5} μg/mL raloxifene with 2.50×10^{-5} μg/mL E2) in duplicate as the reference standard, with three replicate wells for the E2 and DMSO controls. Range finder testing uses all wells of the 96-well plate.

Comprehensive testing is conducted on 96-well plates using nine concentrations of Ral/E2 in duplicate as the reference standard (**Table 6-1**). Three replicate wells for the DMSO control,

Flavone/E2 and E2 controls are included on each plate. In order to avoid edging effects[3], wells on the perimeter of the plate are not used for experiments. These wells should contain tissue culture media only.

Table 6-1 Concentrations of Ral/E2 Reference Standard Used in Comprehensive Testing

Raloxifene Concentrations[1]	E2 Concentrations
1.25×10^{-2}	2.5×10^{-5}
6.25×10^{-3}	2.5×10^{-5}
3.13×10^{-3}	2.5×10^{-5}
1.56×10^{-3}	2.5×10^{-5}
7.81×10^{-4}	2.5×10^{-5}
3.91×10^{-4}	2.5×10^{-5}
1.95×10^{-4}	2.5×10^{-5}
9.77×10^{-5}	2.5×10^{-5}
4.88×10^{-5}	2.5×10^{-5}

[1]Concentrations are presented in μg/mL.

Visual observations for cell viability are conducted for all experimental plates just prior to LUMI-CELL® ER evaluation. CellTiter-Glo® based cell viability testing (when used) is conducted concurrently in parallel plates on the same day, as outlined in **Section 11.4**.

Luminescence data, measured in relative light units (RLUs), is corrected for background luminescence by subtracting the mean RLU value of the vehicle control (DMSO) wells from the RLU measurements for each of the other wells of the 96-well plate. Data is then transferred into Excel® data management spreadsheets and GraphPad PRISM® 4.0 statistical software, graphed, and evaluated for a positive or negative response as follows:

- A response is considered positive for antagonist activity when the average adjusted RLU for a given concentration is less than the mean RLU value minus three times the standard deviation for the E2 control.
- Any luminescence at or above this threshold is considered a negative response.

[3]Edging effects are variations in response seen in the outermost wells in a cell culture plate. These variations are believed to be due to variations in temperature, evaporation, etc., that may occur in these wells that would ultimately affect cellular growth and health (ICCVAM, 2001).

For substances that are positive at one or more concentrations, the concentration of test substance that causes a half-maximal response (the relative IC_{50}) is calculated using a Hill function analysis. The Hill function is a four-parameter logistic mathematical model relating the substance concentration to the response (typically following a sigmoidal curve) using the equation below

$$Y = \text{Bottom} + \frac{\text{Top} - \text{Bottom}}{1 + 10^{(\log IC50 - X)\text{HillSlope}}}$$

where Y = response (i.e., relative light units); X = the logarithm of concentration; Bottom = the minimum response; Top = the maximum response; log IC_{50} = the logarithm of X as the response midway between Top and Bottom; and HillSlope describes the steepness of the curve. The model calculates the best fit for the Top, Bottom, HillSlope, and IC_{50} parameters. See **Section 13.6.5** for more details.

Acceptance or rejection of a test is based on evaluation of reference standard and control results from each experiment conducted on a 96-well plate. Results for these controls are compared to historical results compiled in the historical database, as seen in **Section 16.0**.

6.1 Range Finder Testing

Antagonist range finding for coded substances consists of a six point, logarithmic serial dilution using duplicate wells per concentration. Concentrations for comprehensive testing are selected based on the response observed in range finder testing. If necessary, a second range finder test can be conducted to clarify the optimal concentration range to test (see **Section 14.0)**.

6.2 Comprehensive Testing

Comprehensive antagonist testing for coded substances consists of 11 point, double serial dilutions, with each concentration tested in triplicate wells of the 96-well plate. Three separate experiments are conducted for comprehensive testing on three separate days, except during Phases III and IV of the validation effort, in which comprehensive testing experiments are conducted once (see **Section 15.0)**.

7.0 MATERIALS FOR LUMI-CELL® ER ANTAGONIST TESTING

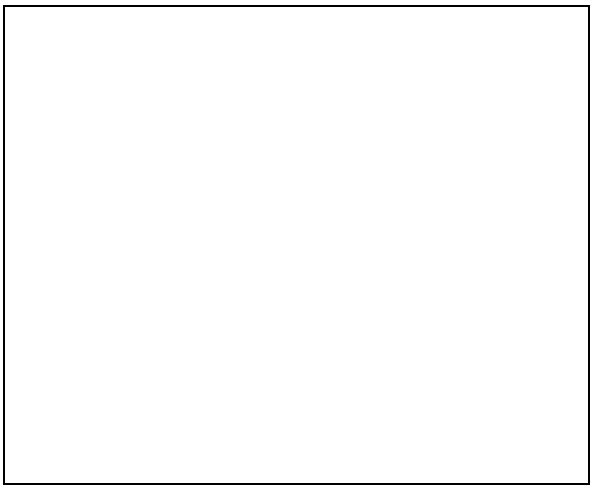
This section provides the materials needed to conduct LUMI-CELL® ER testing, with associated brand names/vendors[4] in brackets.

[4]Brand names and vendors should not be considered an endorsement by the U.S. Government or any member of the U.S. Government; such information is provided as examples.

7.1 BG1Luc4E2 Cells:

Human ovarian cancer cell line stably transfected with a plasmid containing an estrogen response element (**Figure 7-1**) [XDS].

Figure 7-1 pGudLuc7.ERE Plasmid.



7.2 Technical Equipment:

All technical equipment may be obtained from Fisher Scientific International, Inc. (Liberty Lane Hampton, NH, USA 03842). Equivalent technical equipment from another commercial source can be used.

- Analytical balance (Cat. No. 01-910-320)
- Berthold Orion 1 Microplate Luminometer [Berthold CatNo.: Orion 1 MPL3] or equivalent and dedicated computer
- Biological safety hood, class II, and stand (Cat. No. 16-108-99)
- Centrifuge (low speed, tabletop with swinging bucket rotor) (Cat. No. 04-978-50 centrifuge, and 05-103B rotor)
- Combustion test kit (CO_2 monitoring) (Cat. No. 10-884-1)
- Drummond diaphragm pipetter (Cat. No. 13-681-15)
- Freezers, –20°C (Cat. No. 13-986-150), and –70°C (Cat. No. 13-990-86)
- Hand tally counter (Cat. No. 07905-6)
- Hemocytometer, cell counter (Cat. No. 02-671-5)
- Light microscope, inverted (Cat. No. 12-561-INV)
- Light microscope, upright (Cat. No. 12-561-3M)

- Liquid nitrogen flask (Cat. No. 11-675-92)
- Micropipetter, repeating (Cat. No. 21-380-9)
- Pipetters, air displacement, single channel (0.5 –10µl (Cat. No. 21-377-191), 2 – 20 µl (Cat. No. 21-377-287), 20 – 200 µl (Cat. No. 21-377-298), 200 - 1000 µl (Cat. No. 21-377-195))
- Refrigerator/freezer (Cat. No. 13-986-106A)
- Shaker for 96-well plates (Cat. No. 14-271-9)
- Sodium hydroxide (Cat. No. 5318-500)
- Sonicating water bath (Cat. No. 15-335-30)
- Tissue culture incubator with CO_2 and temperature control (Cat. No. 11-689-4)
- Vacuum pump with liquid trap (side arm Erlenmeyer) (Cat. No. 01-092-29)
- Vortex mixer (Cat. No. 12-814)

Equipment should be maintained and calibrated as per GLP guidelines and individual laboratory SOPs.

7.3 Reference Standard, Controls, and Tissue Culture Supplies

All tissue culture reagents must be labeled to indicate source, identity, storage conditions and expiration dates. Tissue culture solutions must be labeled to indicate concentration, stability (where known), and preparation and expiration dates.

Equivalent tissue culture media and sera from another commercial source can be used, but must first be tested as described in **Section 17.0** to determine suitability for use in this test method.

The following are the necessary tissue culture reagents and possible sources based on their use in the pre-validation studies:

- 17 β-estradiol (CAS RN: 50-28-2) [Sigma-Aldrich, Cat. No. E8875]
- CellTiter-Glo® Luminescent Cell Viability Assay [Promega Cat. No. G7572]
- Cryovial, 2 mL (Corning Costar) [Fisher Scientific Cat. No. 03-374-21]
- Culture tube 13 x 100mm (case) [Thomas Scientific Cat. No.: 10009186R38]
- Culture tube, 50 mL conical (Corning Costar) [Fisher Scientific Cat. No. 05-526C]
- DMSO, U.S.P. analytical grade. [Sigma-Aldrich, Cat. No. 34869-100ML]
- Dulbecco's Modification of Eagle's Medium (DMEM), containing 4.5 g/L glucose, with sodium pyruvate, without phenol red or L-glutamine [Mediatech/Cellgro, Cat. No. 17-205-CV]

- Fetal Bovine Serum [Mediatech/Cellgro Cat. No. MT 35-010-CV]
- Fetal Bovine Serum, charcoal/dextran treated, triple 0.1 μm sterile filtered [Hyclone, Cat. No. SH30068.03]
- Flavone (CASRN: 525-82-6) [Sigma-Aldrich, Cat. No. F2003]
- Gentamycin Sulfate (G418), 50 mg/mL [Mediatech/Cellgro Cat. No. 30-234-CR]
- L-glutamine, 29.2 mg/mL [Cellgro, Cat. No. 25005-CI]
- Luciferase Assay System (10-Pack) [Promega Cat. No. E1501]
- Lysis Solution 5X [Promega, Cat. No. E1531]
- Penicillin/streptomycin solution, 5000 I.U. penicillin, 5000 μg/mL streptomycin [Cellgro, Cat. No. 30-001-CI].
- Phosphate buffered saline (PBS, 1X) without calcium and magnesium [Cellgro, Cat. No. 21-040-CV]
- Pipettes, serological: 2.0 mL [Sigma-Aldrich, Cat. No. P1736], 5.0 mL [Sigma-Aldrich, Cat. No. P1986], 25 mL [Sigma-Aldrich, Cat. No. P2486]
- Raloxifene (CASRN 84449-90-1) [Sigma-Aldrich Cat. No. R1402]
- RPMI 1640 medium, containing L-glutamine [Mediatech, Cat. No. 10-040-CV]
- Tissue culture flasks (Corning-Costar): 25 cm^2 (T25) [Fisher Cat. No. 10-126-28]; 75 cm^2 (T75) [Fisher Cat. No. 10-126-37]; and 150 cm^2 (T150) [Fisher Cat. No. 10-126-34]
- Tissue culture plates (Corning-Costar): 96-well [Thomas Scientific Cat. No. 6916A05]
- Trypsin (10X), 2.5% in Hank's balanced salt solution (HBSS), without calcium and magnesium, without phenol red [Cellgro, Cat. No. 25-054-CI].

All reagent lot numbers and expiration dates must be recorded in the study notebook.

8.0 PREPARATION OF TISSUE CULTURE MEDIA AND SOLUTIONS

All tissue culture media and media supplements must be quality tested before use in experiments (see **Section 15.0**).

8.1 RPMI 1640 Growth Medium (RPMI)

RPMI 1640 is supplemented with 0.9% Pen-Strep and 8.0% FBS to make RPMI growth medium (RPMI).

Procedure for one 549 mL bottle:

1. Remove FBS from -70°C freezer, and Pen-Strep from -20°C freezer and allow to equilibrate to room temperature.
2. Add 44 mL of FBS and 5 mL Pen-Strep to the bottle of RPMI 1640.
3. Label RPMI bottle as indicated in **Section 7.3**

Store at 2-8°C for no longer than six months or until the shortest expiration date of any media component.

8.2 Estrogen-Free DMEM Medium

DMEM is supplemented to contain 4.5% charcoal/dextran treated FBS, 1.9% L-glutamine, 0.9% Pen-Strep.

Procedure for one 539 mL bottle:

1. Remove charcoal/dextran treated FBS from -70°C freezer, and L-glutamine and Pen-Strep from -20°C freezer and allow to equilibrate to room temperature.
2. Add 24 mL of charcoal/dextran treated FBS, 10 mL L-glutamine, and 5 mL Pen-Strep to one 500 mL bottle of DMEM.
3. Label estrogen-free DMEM bottle as indicated in **Section 7.3**

Store at 2-8°C for no longer than six months or until the shortest expiration date of any media component.

8.3 1X Trypsin Solution

1X trypsin solution is prepared by dilution from a 10X premixed stock solution. The 10X stock solution should be stored in 10 mL aliquots in a -20°C freezer.

Procedure for making 100 mL of 1X trypsin:

1. Remove a 10mL aliquot of 10X trypsin from -20°C freezer and allow to equilibrate to room temperature.
2. Aliquot 1 mL trypsin (10X) along with 9 mL of 1X PBS into ten 15 mL centrifuge tubes.
3. Label 1X trypsin aliquots as indicated in **Section 7.3**

1X trypsin should be stored at -20°C.

8.4 1X Lysis Solution

Lysis solution is prepared by dilution from a 5X premixed stock solution. Both the 5X and 1X solutions can be repeatedly freeze-thawed.

The procedure for making 10 mL of 1X lysis solution:

1. Thaw the 5X Promega Lysis solution and allow it to reach room temperature.
2. Remove 2 mL of 5X solution and place it in a 15 mL conical centrifuge tube.
3. Add 8 mL of distilled, de-ionized water to the conical tube.
4. Cap and shake gently until solutions are mixed.

Store at -20°C for no longer than 1 year from receipt.

8.5 Reconstituted Luciferase Reagent

Luciferase reagent consists of two components, luciferase buffer and lyophilized luciferase substrate.

For long-term storage, unopened containers of the luciferase buffer and lyophilized luciferase substrate can be stored at -70°C for up to six months.

To reconstitute luciferase reagent:

1. Remove luciferase buffer and luciferase substrate from -70°C freezer and allow them to equilibrate to room temperature.
2. Add 10 mL of luciferase buffer solution to luciferase substrate container and swirl or vortex to mix, the Luciferase substrate should readily go into solution.
3. Luciferase substrate should readily go into solution.
4. After solutions are mixed aliquot to a 15mL centrifuge tube.
5. Store complete solution at –20°C.

Reconstituted luciferase reagent is stable for 1 month at –20°C.

8.6 Reconstituted CellTiter-Glo® Reagent

CellTiter-Glo® reagent consists of two components, CellTiter-Glo® buffer and lyophilized CellTiter-Glo® substrate.

For long term storage, unopened containers of the CellTiter-Glo® buffer and lyophilized CellTiter-Glo® substrate can be stored at -70°C for up to one year.

To reconstitute CellTiter-Glo® reagent:

1. Remove CellTiter-Glo® buffer and CellTiter-Glo® substrate from -70°C freezer and allow them to equilibrate to room temperature.
2. Add CellTiter-Glo® buffer solution to CellTiter-Glo® substrate container and swirl or vortex gently to mix; the CellTiter-Glo® substrate should readily go into solution.

3. CellTiter-Glo® substrate should readily go into solution.
4. After solutions are mixed aliquot to a 15mL centrifuge tube.
5. Store complete solution at –20°C.

Reconstituted CellTiter-Glo® reagent is stable for up to 3 months at –20°C.

9.0 OVERVIEW OF PROPAGATION AND EXPERIMENTAL PLATING OF BG1Luc4E2 CELLS

The BG1Luc4E2 (BG-1) cells are stored in liquid nitrogen in 2 mL cryovials. BG-1 cells are grown as a monolayer in tissue culture flasks in a dedicated tissue culture incubator at 37ºC ± 1ºC, 90% ± 5% humidity, and 5.0% ± 1% CO_2/air. The cells should be examined on a daily basis during working days under an inverted phase contrast microscope, and any changes in morphology and adhesive properties must be noted in the study notebook.

Two T150 flasks containing cells at 80% to 90% confluence will usually yield a sufficient number of cells to fill four 96-well plates for use in experiments.

9.1 Procedures for Thawing Cells and Establishing Tissue Cultures

Warm all tissue culture media and solutions to room temperature by placing them under the tissue culture hood several hours before use.

All tissue culture media, media supplements, and tissue culture plasticware must be quality tested before use in experiments (**Section 17.0**).

9.1.1 Thawing Cells

1. Remove a cryovial of frozen BG-1 cells from the liquid nitrogen flask.
2. Facilitate rapid thawing by loosening the top slightly (do not remove top) to release trapped gasses and retightening it. Roll vial between palms.
3. Use a micropipette to transfer cells to a 50 mL conical centrifuge tube.
4. Rinse cryovial twice with 1X PBS and add PBS rinse material to the conical tube.
5. Add 20 mL of RPMI to the conical tube.
6. Centrifuge at 1000 x *g* for eight min. If a pellet of cells has not formed, centrifuge for an additional 5 minutes.
7. Aspirate media from pellet and re-suspend it in 5 mL RPMI, drawing the pellet repeatedly through a 1.0 mL serological pipette to break up any clumps of cells.
8. Transfer cells to a T25 flask, place them in an incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).

9.1.2 Establishing Tissue Cultures

Once cells have reached 80% to 90% confluence, transfer the cells to a T75 flask by performing, for example, the following steps:

1. Remove the T25 flask from the incubator.
2. Aspirate the RPMI, then add 5 mL 1X PBS, making sure that the cells are coated with PBS.
3. Aspirate 1X PBS, then add 1 to 2 mL 1X trypsin to the T25 flask, gently swirling the flask to coat all cells with the trypsin.
4. Place the flask in an incubator (see conditions in **Section 9.0**) for 5 to 10 min.
5. Detach cells by hitting the side of the flask sharply against the palm or heel of the hand.
6. Confirm cell detachment by examination under an inverted microscope. If cells have not detached, return the flask to the incubator for an additional 2 minutes, then hit the flask again.
7. After cells have detached, add 5 mL PBS, and transfer the suspended cells to a 50 mL centrifuge tube. Wash the flask one additional time with 5 mL PBS.
8. Immediately add 20 mL RPMI to the conical tube to inhibit further cellular digestion by residual trypsin.
9. Pellet the cells by centrifugation, as described in **Section 9.1.1**, and re-suspend the cells in 10 mL RPMI medium.
10. Draw the pellet repeatedly through a 25 mL serological pipette to break up clumps of cells
11. Transfer cells to a T75 flask, then place the flask in an incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).

When cells have reached 80% to 90% confluence, transfer them into a T150 flask by performing, for example, the following steps:

12. Remove the T75 flask from the incubator, aspirate the old media and add 5 mL 1X PBS.
13. Aspirate 1X PBS, add 2 mL of 1X trypsin to the flask, and place it in an incubator (see conditions in **Section 9.0**) for 5 to 10 min.
14. Repeat **steps 5** through **11** in **Section 9.1.2,** re-suspending the pellet in 20 mL of RPMI.
15. Transfer cells to a T150 flask and place it in the incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).
16. Remove the T150 flask from the incubator.

17. Aspirate the RPMI and add 5 mL 1X PBS.
18. Aspirate 1X PBS and add 3 mL 1X trypsin to the T150 flask, making sure that the cells are coated with the trypsin.
19. Incubate cells in an incubator (see conditions in **Section 9.0**) for 5 to 10 min.
20. Detach cells by hitting the side of the flask sharply against the palm or heel of the hand.
21. Confirm cell detachment by examination under an inverted microscope. If cells have not detached, return the flask to the incubator for an additional 2 minutes, then hit the flask again.
22. After cells have detached, add 5mL 1X PBS and transfer the suspended cells from the T150 flask to a 50 mL conical tube. Add an additional 5 mL PBS to the flask, then transfer to the 50 mL conical tube.
23. Immediately add 20 mL RPMI to the conical tube to inhibit further cellular digestion by residual trypsin.
24. Centrifuge at 1000 x *g* for eight minutes. If a pellet of cells has not formed, centrifuge for an additional 5 minutes.
25. Aspirate the media from the pellet and re-suspend it in 40 mL RPMI, drawing the pellet repeatedly through a 25 mL serological pipette to break up any clumps of cells.
26. Transfer 20 mL of cell suspension to each of two T150 flasks, place them in an incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).

9.2 Ongoing Tissue Culture Maintenance, Conditioning in Estrogen-free Medium, and Plating Cells for Experimentation

The following procedure is used to condition the BG1Luc4E2 cells to an estrogen-free environment prior to plating the cells in 96-well plates for analysis of estrogen dependent induction of luciferase activity.

To start the tissue culture maintenance and estrogen-free conditioning, split the two T150 culture flasks into four T150 flasks. Two of these flasks will be used for continuing tissue culture and will use the RPMI media mentioned above. The other two flasks will be cultured in estrogen-free DMEM for experimental use. Extra care must be taken to avoid contaminating the estrogen-free cells with RPMI.

1. Remove both T150 flasks from the incubator.
2. Aspirate the medium and rinse the cells with 5 mL 1X PBS.

3. Aspirate 1X PBS, then add 3 mL 1X trypsin to the flasks, gently swirling the flask to coat all cells with the trypsin.
4. Incubate cells in the incubator (see conditions in **Section 9.0**) for 5 to 10 min.
5. Detach cells by hitting the side of the flask sharply against the palm or heel of the hand.
6. Confirm cell detachment by examination under an inverted microscope. If cells have not detached, return the flask to the incubator for an additional 2 minutes, then hit the flask again.
7. After cells have detached, add 5 mL 1X PBS to the first T150 flask and transfer the suspended cells to the second T150 flask.
8. Transfer the contents of both flasks to a 50 mL conical tube. Repeat step 7 with an additional 5 mL 1X PBS and transfer to the 50 mL conical tube.
9. Immediately add 20 mL estrogen-free DMEM to the 50 mL conical tube to inhibit further cellular digestion by residual trypsin.
10. Centrifuge at 1000 x *g* for eight minutes. If a pellet of cells has not formed, centrifuge for an additional 5 minutes.
11. Aspirate media from pellet and re-suspend it in 4 mL estrogen-free DMEM, drawing the pellet repeatedly through a 1 mL serological pipette to break up clumps of cells.

At this point, cells are ready to be divided into the ongoing tissue culture and estrogen-free conditioning groups.

9.2.1 Ongoing Tissue Culture Maintenance

1. Add 20 mL RPMI to two T150 flasks.
2. Add 220 μL G418 to the RPMI in the T150 flasks
3. Add 1 mL of cell suspension from **Section 9.2 step 11** to each flask.
4. Place T150 flasks in tissue culture incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).
5. Tissue culture medium may need to be changed 24 hours after addition of G418 to remove cells that have died because they do not express reporter plasmid.
6. G418 does not need to be added to the flasks a second time.
7. Repeat **Section 9.2 steps 1-11** for ongoing tissue culture maintenance.

9.2.2 Conditioning in Estrogen-free Medium

1. Add 20 mL estrogen-free DMEM to two T150 flasks.

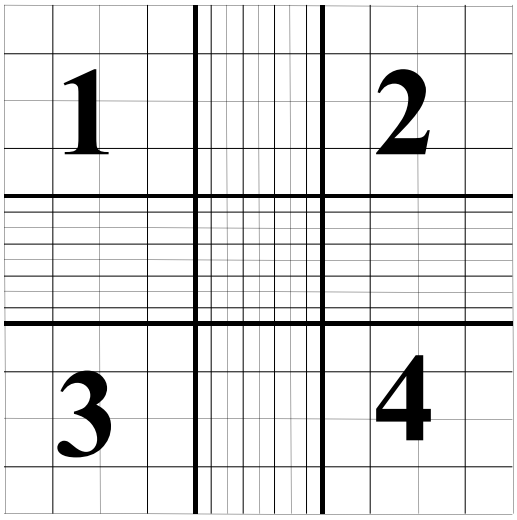
2. Add 150 µL G418 to the estrogen-free DMEM in the T150 flasks.
3. Add 1 mL of cell suspension from **Section 9.2 step 11** to each flask.
4. Tissue culture medium may need to be changed 24 hours after addition of G418 to remove cells that have died because they do not express reporter plasmid.
5. G418 does not need to be added to the flasks a second time.
6. Place the T150 flasks in the incubator (see conditions in **Section 9.0**) and grow to 80% to 90% confluence (approximately 48 to 72 hrs).

9.2.3 Plating Cells Grown in Estrogen-free DMEM for Experimentation

1. Remove the T150 flasks that have been conditioned in estrogen-free DMEM for 48 to 72 hours from the incubator.
2. Aspirate the medium, then rinse the cells with 5 mL 1X PBS.
3. Aspirate 1X PBS, then add 3 mL 1X trypsin to the flasks, gently swirling the flask to coat all cells with the trypsin.
4. Place the flasks in an incubator (see conditions in **Section 9.0**) for 5 to 10 min.
5. Detach cells by hitting the side of the flask sharply against the palm or the heel of the hand.
6. Confirm cell detachment by examination under an inverted microscope. If cells have not detached, return the flask to the incubator for 2 additional minutes, then hit the flask again.
7. After cells have detached, add 5 mL 1X PBS and transfer the suspended cells from the T150 flask to a 50 mL conical tube. Add an additional 5 mL PBS to the flask, then transfer to the 50 mL conical tube.
8. Immediately add 20 mL estrogen-free DMEM to each conical tube to inhibit further cellular digestion by residual trypsin.
9. Centrifuge at 1000 x *g* for eight minutes. If a pellet of cells has not formed, centrifuge for an additional 5 minutes.
10. Aspirate off the media from the pellet and re-suspend it in 20 mL DMEM, drawing the pellet repeatedly through a 25 mL serological pipette to break up any clumps of cells.
11. Pipette 15 µL of the cell suspension into the "v" shaped slot on the hemocytometer. Ensure that the solution covers the entire surface area of the hemocytometer grid, and allow cells to settle before counting.
12. Using 100x magnification, view the counting grid.

13. The counting grid on the hemocytometer consists of nine sections, four of which are counted (upper left, upper right, lower left, and lower right, see **Figure 9-1**). Each section counted consists of four by four grids. Starting at the top left and moving clockwise, count all cells in each of the four by four grids. Some cells will be touching the outside borders of the square, but only count those that touch the top and right borders of the square. This value is then used in the calculation below to get to the desired concentration of 200,000 cells/mL.

Figure 9-1 Hemocytometer Counting Grid.



The volume of each square is 10^{-4} mL, therefore:
Cells/mL = (average number per grid) x 10^{-4} mL. x 1/(starting dilution).
Starting dilution: 20mL (for T150 flasks)

Harvested cells for a T150 flask are suspended in 20 mL of estrogen-free DMEM and sampled for determination of concentration of cells/mL.

Example Calculation:

- Grids 1, 2, 3, and 4 are counted and provide the following data:
  - 50, 51, 49, and 50: average number of cells per grid is equal to 50.

Cells/mL = 50 cells per grid ÷ 10^{-4} mL volume of grid = 50 X 10^{4} cells/mL (or 500,000 cells/mL)
Total # of Cells Harvested = 500,000 cells/mL x 20 mL
Desired Concentration (or Concentration $_{Final}$)= 200,000 cells/mL
Formula: (Concentration $_{Final}$ x Volume $_{Final}$ = Concentration $_{Initial}$ x Volume $_{Initial}$)

Concentration $_{Final}$ = 200,000 cells/mL

Concentration $_{Initial}$ = 500,000 cells/mL
Volume $_{Initial}$ = 20 mL
Volume $_{Final}$ – to be solved for.

Therefore: 200,000 cells/mL x Volume $_{Final}$ = 500,000 cells/mL x 20 mL

Solving for Volume $_{Final}$ we find = 50 mL

Therefore, add 30 mL of estrogen-free DMEM to the cell suspension for a total volume of 50 mL, which will yield the desired concentration of 200,000 cells/mL for plating.

14. This dilution scheme will give a concentration of 200,000 cells/mL. 200 µL of this cell suspension is used for each well of a 96-well plate (i.e., 40,000 cells per well).
15. Remove a 96-well plate from its sterile packaging. Use a repeater pipetter to pipette:
    - 200 µL of cell suspension into each well for range finder testing
    - 200 µL of cell suspension into each well except the outside ring of wells for comprehensive testing and add 200 µL of estrogen-free DMEM to the outside ring of wells
16. Incubate plate(s) in an incubator (see conditions in **Section 9.0**) for a minimum of 24 hours, but no longer than 48 hours before dosing.

Two T150 flasks containing cells at 80% to 90% confluence will typically yield sufficient cells to fill four 96-well plates (not including the perimeter wells).

10.0 PREPARATION OF TEST SUBSTANCES

The solvent used for dissolution of test substances is 100% DMSO. All test substances should be allowed to equilibrate to room temperature before being dissolved and diluted. Test substance solutions (except for reference standards and controls) should not be prepared in bulk for use in subsequent tests. Test substances are to be used within 24 hours of preparation. Solutions should not have noticeable precipitate or cloudiness.

All information on weighing, solubility testing, and calculation of final concentrations for test substances, reference standards and controls is to be recorded in the study notebook.

10.1 Determination of Test Substance Solubility

1. Prepare a 200 mg/mL solution of the test substance in 100% DMSO in a 4 mL conical tube.
2. Vortex to mix.

3. If the test substance does not dissolve at 200 mg/mL, prepare a 20 mg/mL solution and vortex as above.
4. If the test substance does not dissolve at 20 mg/mL solution, prepare a 2 mg/mL solution in a 4 mL conical tube and vortex as above.
5. If the test substance does not dissolve at 2 mg/mL, prepare a 0.2 mg/mL solution in a 4 mL conical tube and vortex as above.
6. Continue testing, using 1/10 less substance in each subsequent attempt until test substance is solubilized in DMSO.

Once a solution of test substance has been obtained that does not have any visible precipitate or cloudiness in 100% DMSO, the solubility of the test substance must be determined in the 1% DMSO/99% estrogen-free DMEM mixture used for LUMI-CELL® ER testing.

7. Add 2 µL of the highest concentration of the test substance/DMSO solution to a 13 mm test tube.
8. Add 400 µL estrogen-free DMEM to the test tube and vortex gently,
9. If cloudiness or precipitate develop, vortex for up to 10 minutes.
10. If vortexing does not dissolve test substance, sonicate test substance for up to 10 minutes.
11. If test substance has visible precipitate or is cloudy return to **Section 10.1 step 7** to try the next lower concentration for the test substance.

The Testing Facility shall forward the results from the solubility tests assay to the SMT through the designated contacts in electronic format and hard copy upon completion of testing.

11.0 PREPARATION OF REFERENCE STANDARD, CONTROL AND TEST SUBSTANCE STOCK SOLUTIONS FOR RANGE FINDER AND COMPREHENSIVE TESTING

All information on preparation of test substances, reference standards and controls is to be recorded in the study notebook.

11.1 Preparation of Ral/E2 Stock Solutions

E2 and raloxifene stocks are prepared separately and then combined into Ral/E2 stocks, which are then used to prepare dosing solutions in **Section 12**.

11.1.1 E2 Stock Solution

The final concentration of the E2 stock solution is 5.0×10^{-3} µg/mL. Prepare the E2 stock as shown in **Table 11-1**.

Table 11-1 Preparation of E2 Stock Solution

Step #	Action	DMSO	E2 Concentration
1	Make a 10 mg/mL stock solution in 100% DMSO in a 4mL vial.	-	10 mg/mL
2	Transfer 10 µL E2 solution from Step #1 to a new 4 mL vial.	Add 990 µL of 100% DMSO. Vortex to mix.	100 µg/mL
3	Transfer 10 µL E2 solution from Step #2 to a new 4mL vial.	Add 990 µL of 100% DMSO. Vortex to mix.	1 µg/mL
4	Transfer 100 µL E2 solution from Step #3 to a new glass container large enough to hold 15 mL.	Add 9.90 mL of 100% DMSO. Vortex to mix.	1.0×10^{-2} µg/mL
5	Transfer 5 mL E2 solution from Step #4 to a new glass container large enough to hold 15 mL	Add 5 mL of 100% DMSO. Vortex to mix.	5.0×10^{-3} µg/mL

11.1.2 Raloxifene Working Stock Solution

Prepare a 2.5 µg/mL raloxifene working stock solution as shown in **Table 11-2**.

Table 11-2 Preparation of Raloxifene Working Stock Solution

Step #	Action	DMSO	Raloxifene Concentration
1	Make a 10 mg/mL solution of raloxifene in a 4 mL glass vial.	-	1.0×10^{4} µg/mL
2	Transfer 10 µL raloxifene solution from Step #1 to a new 4 mL vial.	Add 990 µL of 100% DMSO. Vortex to mix.	100 µg/mL
3	Transfer 150 µL raloxifene solution from Step #2 to a new 4 mL vial.	Add 2.850 mL of 100% DMSO. Vortex to mix.	5 µg/mL
4	Transfer 1.5 mL raloxifene solution from Step #3 to a new 13 mm test tube.	Add 1.5 mL of 100% DMSO. Vortex to mix.	2.5 µg/mL

11.2 Ral/E2 Range Finder Stock

11.2.1 Raloxifene Dilutions

Number three 4 mL vials with the numbers 1 to 3 and use the raloxifene solution prepared in **Section 11.1.2** to make raloxifene dilutions as shown **Table 11-3**.

Table 11-3 Preparation of Raloxifene Reference Standard for Range Finder Testing

Step #	Action	DMSO	Raloxifene Concentration
1	Transfer 500 µL of the raloxifene working stock solution to a new 4 mL vial.	-	2.5 µg/mL
2	Transfer 50 µL of the raloxifene working stock solution to a new 4 mL vial.	Add 500 µL of 100% DMSO. Vortex to mix.	2.50×10^{-1} µg/mL
3	Transfer 2 µL of the raloxifene working stock solution to a new 4 mL vial.	Add 500 µL of 100% DMSO. Vortex to mix.	1.00×10^{-2} µg/mL

11.2.2 Ral/E2 Dilutions for Range Finder Stock:

Add 500 µL of the 5 x 10^{-3} µg/mL E2 solution prepared in **Section 11.1.1** to each of the raloxifene dilution vials prepared in **Section 11.2.1**. Vortex each tube to mix. The final concentrations for raloxifene and E2 are listed in **Table 11-4**.

Table 11-4 Concentrations of Raloxifene and E2 in the Ral/E2 Range Finder Stock Solution

Tube #	Raloxifene (µg/ml)	E2 (µg/ml)
1	1.25	2.5 x 10^{-3}
2	1.25 x 10^{-1}	2.5 x 10^{-3}
3	5.00 x 10^{-3}	2.5 x 10^{-3}

11.3 Ral/E2 Comprehensive Testing Stock

11.3.1 Raloxifene Dilutions for Comprehensive Testing Stock

Use the raloxifene solution prepared in **Section 11.1.2** to make a 9-point serial dilution of raloxifene as shown **Table 11-5**.

Table 11-5 Preparation of Raloxifene 9-Point Serial Dilution

Step #	Action	DMSO	Discard	Raloxifene Concentration
1	Transfer 500 µL of the raloxifene working stock solution to a new 4 mL vial.	-	-	2.5 µg/mL
2	Transfer 500 µL of the raloxifene working stock solution to a new 4 mL vial.	Add 500 µL of 100% DMSO. Vortex to mix.	-	1.25 µg/mL
3	Transfer 500 µL raloxifene solution from Step #2 to a new 4 mL vial.	Add 500 µL of 100% DMSO. Vortex to mix.	-	6.25 x 10^{-1} µg/mL
4	Transfer 500 µL raloxifene solution from Step #3 to a new 4 mL vial.	Add 500 µL of 100% DMSO. Vortex to mix.	-	3.13 x 10^{-1} µg/mL
5	Transfer 500 µL raloxifene solution from Step #4 to a new 4 mL vial.	Add 500 µL of 100% DMSO. Vortex to mix.	-	1.56 x 10^{-1} µg/mL
6	Transfer 500 µL raloxifene solution from Step #5 to a new 4 mL vial.	Add 500 µL of 100% DMSO. Vortex to mix.	-	7.81 x 10^{-2} µg/mL
7	Transfer 500 µL raloxifene solution from Step #6 to a new 4 mL vial.	Add 500 µL of 100% DMSO. Vortex to mix.	-	3.91 x 10^{-2} µg/mL
8	Transfer 500 µL raloxifene solution from Step #7 to a new 4 mL vial.	Add 500 µL of 100% DMSO. Vortex to mix.		1.95 x 10^{-2} µg/mL
9	Transfer 500 µL raloxifene solution from Step #8 to a new 4 mL vial.	Add 500 µL of 100% DMSO. Vortex to mix.	Discard 500 µL from Tube #9	9.77 x 10^{-3} µg/mL

11.3.2Ral/E2 Dilutions for Comprehensive Testing Stock:

Add 500 µL of the 5 x 10^{-3} µg/mL E2 solution prepared in **Section 11.1.1** to each of the 9 raloxifene dilution vials (including the working stock solution in Tube #1). Vortex each tube to mix. The final concentrations for raloxifene and E2 are listed in **Table 11-6**.

Table 11-6 Concentrations of Raloxifene and E2 in the Ral/E2 Stock Solution

Tube #	Raloxifene (µg/mL)	E2 (µg/mL)
1	1.25	2.5 x 10^{-3}
2	6.25 x 10^{-1}	2.5 x 10^{-3}
3	3.13 x 10^{1}	2.5 x 10^{-3}
4	1.56 x 10^{-1}	2.5 x 10^{-3}
5	7.81 x 10^{2}	2.5 x 10^{-3}
6	3.91 x 10^{-2}	2.5 x 10^{-3}
7	1.95 x 10^{-2}	2.5 x 10^{-3}
8	9.77 x 10^{-3}	2.5 x 10^{-3}
9	4.88 x 10^{-3}	2.5 x 10^{-3}

11.4 Flavone/E2 Stock Solution

To prepare the flavone/E2 stock solution, proceed as follows:

1. Prepare 1 mL of 10 mg/mL flavone
2. Add 1 mL of the 5x10^{-3} µg/mL E2 (prepared as in **Section 11.1.1**) to the 10 mg/mL flavone. This will make a working solution of 5 mg/mL flavone with 2.5x10^{-3} µg/mL E2.

12.0 PREPARATION OF REFERENCE STANDARD, CONTROL AND TEST SUBSTANCE DOSING SOLUTIONS FOR RANGE FINDER AND COMPREHENSIVE TESTING

12.1 Preparation of Reference Standard and Control Dosing Solutions for Range Finder Testing

Range finder testing is conducted on 96-well plates using three concentrations of Ral/E2 in duplicate as the reference standard. Three replicate wells for the DMSO, and E2 controls are included on each plate.

All "dosing solutions" of test substance concentrations are to be expressed as *µg/mL* in the study notebook and in all laboratory reports.

Dosing solutions are to be used within 24 hours of preparation.

12.1.1 Preparation of Ral/E2 Reference Standard Range Finder Dosing Solutions

1. Label two sets of 13 mm glass tubes with the numbers 1 to 3.
2. Add 4 µL of Ral/E2 stock from tube #1 from **Section 11.2.2** to the two 13 mm glass test tubes labeled #1.
3. Add 4 µL of Ral/E2 stock from tube #2 from **Section 11.2.2** to the two 13 mm glass test tubes labeled #2. Repeat for tubes #3.
4. Add 400 µL of estrogen-free DMEM to each tube and vortex to mix.

12.1.2 Preparation of DMSO Control Range Finder Dosing Solution

1. Add 4 µL of 100% DMSO to three 13 mm glass test tubes.
2. Add 400 µL of estrogen-free DMEM to each tube and vortex to mix.

12.1.3 Preparation of E2 Control Range Finder Dosing Solution

1. Add 2 µL of the E2 stock from **Section 11.1.1** to three 13 mm glass test tube.
2. Add 400 µL of estrogen-free DMEM to each tube and vortex to mix.

12.2 Preparation of Test Substance Dosing Solutions for Range Finder Testing

Range finder experiments are used to determine the concentrations of test substance to be used during comprehensive testing. Antagonist range finding for coded substances consists of six-point, logarithmic serial dilutions.

To prepare test substance dosing solutions:

1. Label two sets of six glass 13 mm test tubes with the numbers 1 through 6 and place them in a test tube rack. Perform a serial dilution of test substance as shown in **Table 12-1**.

Table 12-1 Preparation of Test Substance Serial Dilution for Range Finder Testing

Tube #	100% DMSO	Test Substance[1]	Final Volume
1	-	10 µL of test substance solution from **Section 10.1**	100 µL
2	90 µL	10 µL of test substance solution from **Section 10.1**	100 µL
3	90 µL	10 µL from Tube #2	100 µL
4	90 µL	10 µL from Tube #3	100 µL
5	90 µL	10 µL from Tube #4	100 µL
6	90 µL	10 µL from Tube #5	100 µL

[1]Vortex tubes #2 through 5 before removing test substance/DMSO solution to place in the next tube in the series.

2. Transfer test substance/DMSO solutions to new tubes and add E2 as shown in **Table 12-2**.

Table 12-2 Addition of E2 to Test Substance Serial Dilution for Range Finder Testing

Tube Number	Test Substance	E2	Remove	Estrogen-free DMEM[1]	Final Volume
1	Transfer 4 µL of test substance from Tube #1 in **Section 12.2 step 1** to a new tube	Add 4 µL of the 5 x 10^{-3} µg/mL E2 solution prepared in **Section 11.1.1**. Vortex to mix.	Remove and discard 4 µL from Tube #1	400 µL	404 µL
2	Transfer 4 µL of test substance from Tube #2 to a new tube	Add 4 µL of the 5 x 10^{-3} µg/mL E2 solution prepared in **Section 11.1.1** Vortex to mix.	Remove and discard 4 µL from Tube #2	400 µL	404 µL
3	Transfer 4 µL of test substance from Tube #3 to a new tube	Add 4 µL of the 5 x 10^{-3} µg/mL E2 solution prepared in **Section 11.1.1**. Vortex to mix.	Remove and discard 4 µL from Tube #3	400 µL	404 µL
4	Transfer 4 µL of test substance from Tube #4 to a new tube	Add 4 µL of the 5 x 10^{-3} µg/mL E2 solution prepared in **Section 11.1.1**. Vortex to mix.	Remove 4 µL from Tube #4	400 µL	404 µL
5	Transfer 4 µL of test substance from Tube #5 to a new tube	Add 4 µL of the 5 x 10^{-3} µg/mL E2 solution prepared in **Section 11.1.1**. Vortex to mix.	Remove 4 µL from Tube #5	400 µL	404 µL
6	Transfer 4 µL of test substance from Tube #6 to a new tube	Add 4 µL of the 5 x 10^{-3} µg/mL E2 solution prepared in **Section 11.1.1**. Vortex to mix.	Remove 4 µL from Tube #6	400 µL	404 µL

[1]Add 400 µL DMEM to each test tube after removing and discarding 4 µL of test substance/E2 mixture

Determination of whether a substance is positive in range finder testing and selection of starting concentrations for comprehensive testing will be discussed in **Section 14.0**.

12.3 Preparation of Reference Standard and Control Dosing Solutions for Comprehensive Testing

Comprehensive testing is conducted on 96-well plates using nine concentrations of Ral/E2 in duplicate as the reference standard. Three replicate wells for the DMSO, E2 and flavone/E2 controls are included on each plate.

All "dosing solutions" of test substance concentrations are to be expressed as *µg/mL* in the study notebook and in all laboratory reports.

Store dosing solutions at room temperature. Use within 24 hours of preparation.

12.3.1 Preparation of Ral/E2 Reference Standard Dosing Solutions for Comprehensive Testing

In preparation for making Ral/E2 double serial dilutions, label two sets of nine glass 13 mm test tubes with the numbers 1 through 9 and place them in a test tube rack. Tube number 1 will contain the highest concentration of raloxifene (**Table 12-3**).

Table 12-3 Preparation of Ral/E2 Reference Standard Dosing Solution for Comprehensive Testing

Tube Number	Ral/E2 Stock	Estrogen-free DMEM	Final Volume
1	4 µL of Tube #1 from **Section 11.3.2**	400 µL	404 µL
2	4 µL of Tube #2 from **Section 11.3.2**	400 µL	404 µL
3	4 µL of Tube #3 from **Section 11.3.2**	400 µL	404 µL
4	4 µL of Tube #4 from **Section 11.3.2**	400 µL	404 µL
5	4 µL of Tube #5 from **Section 11.3.2**	400 µL	404 µL
6	4 µL of Tube #6 from **Section 11.3.2**	400 µL	404 µL
7	4 µL of Tube #7 from **Section 11.3.2**	400 µL	404 µL
8	4 µL of Tube #8 from **Section 11.3.2**	400 µL	404 µL
9	4 µL of Tube #9 from **Section 11.3.2**	400 µL	404 µL

12.3.2 Preparation of DMSO Control Comprehensive Testing Dosing Solution

1. Add 4 µL of 100% DMSO to three 13 mm glass test tubes.
2. Add 400 µL of estrogen-free DMEM to each tube and vortex to mix.

12.3.3 Preparation of E2 Control Comprehensive Testing Dosing Solution

1. Add 2 µL of the E2 stock from **Section 11.1.1** to three 13 mm glass test tube.
2. Add 400 µL of estrogen-free DMEM to each tube and vortex to mix.

12.3.4 Preparation of Flavone/E2 Control Comprehensive Dosing Solution

1. Add 4 µL of flavone/E2 from **Section 11.4** to three 13 mm glass test tubes.
2. Add 400 µL of estrogen-free DMEM to each tube and vortex to mix.

12.4 Preparation of Test Substance Dosing Solutions for Comprehensive Testing

Comprehensive testing experiments are used to determine whether a substance possesses ER antagonist activity in the LUMI-CELL® ER test method. Antagonist comprehensive testing for

coded substances consists of 11-point, double serial dilutions, with each concentration tested in triplicate wells of the 96-well plate.

To prepare test substance dosing solutions for comprehensive testing:

1. Determine the concentration at which maximal antagonism occurs in the range finder experiment. Start an 11-point serial dilution curve at a 20-fold higher concentration than the concentration causing a maximal antagonist response (i.e., if the maximum antagonist response occurred at 0.01 mg/mL, start the serial dilution curve at 0.2 mg/mL).
2. If there is no observable antagonist response in the range finder experiment, start the serial dilution at the maximum soluble concentration.
3. Label three sets of 11 glass 13 mm test tubes with the numbers 1 through 11 and place them in a test tube rack. Prepare three serial dilutions as in **Table 12-4**.

Table 12-4 Preparation of Test Substance Dosing Solutions for Comprehensive Testing

Tube Number	100% DMSO	Test Substance[1]	Discard	E2 Testing Stock	Discard	Estrogen-free DMEM[2]	Final Volume
1	-	4 µL of test substance solution from **Section 10.2.4 step 1**	-	4 µL	4 µL	400 µL	404 µL
2	4 µL	4 µL of test substance solution from **Section 10.2.4 step 1**	-	4 µL	4 µL	400 µL	404 µL
3	4 µL	4 µL from Tube #2	-	4 µL	4 µL	400 µL	404 µL
4	4 µL	4 µL from Tube #3	-	4 µL	4 µL	400 µL	404 µL
5	4 µL	4 µL from Tube #4	-	4 µL	4 µL	400 µL	404 µL
6	4 µL	4 µL from Tube #5	-	4 µL	4 µL	400 µL	404 µL
7	4 µL	4 µL from Tube #6	-	4 µL	4 µL	400 µL	404 µL
8	4 µL	4 µL from Tube #7	-	4 µL	4 µL	400 µL	404 µL
9	4 µL	4 µL from Tube #8	-	4 µL	4 µL	400 µL	404 µL
10	4 µL	4 µL from Tube #9	-	4 µL	4 µL	400 µL	404 µL
11	4 µL	4 µL from Tube #10	4 µL	4 µL	4 µL	400 µL	404 µL

[1]Vortex tubes #2 through 10 before removing test substance/DMSO solution to place in the next tube in the series.
[2]Vortex all tubes to mix media, test substance, and E2.

13.0 GENERAL PROCEDURES FOR THE TESTING OF CODED SUBSTANCES

Range finder experiments are used to determine the concentrations of test substance to be used during comprehensive testing. Comprehensive testing experiments are used to determine whether a substance possesses ER antagonist activity in the LUMI-CELL® ER test method.

General procedures for range finder and comprehensive testing are nearly identical. For specific details (such as plate layout) of range finder testing see **Section 14.0**. For specific details of comprehensive testing, see **Section 15.0**.

13.1 Application of Reference Standard, Control and Test Substances

1. Remove the 96-well plates (from **Section 9.2.3 step 18)** from the incubator; inspect them using an inverted microscope. Only use plates in which the cells in all wells receive a score of 1 according to **Table 11-1**.
2. Remove medium by inverting the plate onto blotter paper. Gently tap plate against the bench surface to remove residual liquid trapped in the wells.
3. Add 200 µL of medium, reference standard, control or test substance to each well (see **Sections 14.0** and **15.0** for specific plate layouts).
4. Return plates to incubator (see **Section 9.0** for details) for 19 to 24 hours to allow maximal induction of luciferase activity in the cells.

13.1.1 Preparation of Excel® Data Analysis Template

1. In Excel®, open a new "AntICCVAMTemplate" and save it with the appropriate project name as indicated in the NICEATM Style Guide.
2. Add appropriate information regarding the assay to the "Compound Tracking" tab.
3. Enter substance testing information to the "List" page (i.e. Project /Sample ID, Concentration, and Comments (or compound name). This should populate the "Template", "Compound Mixing" and "Visual Inspection" tabs with the appropriate information for the experiment.
4. Save the newly named project file.
5. Print out either the "List" or "Template" page for help with dosing the 96-well plate. Sign and date the print out and store in study notebook.

13.2 Visual Evaluation of Cell Viability

1. 19 to 24 hours after dosing the plate, remove the plate from the incubator and remove the media from the wells by inverting the plate onto blotter paper. Gently tap plate against the bench surface to remove residual liquid trapped in the wells.

2. Use a repeat pipetter to add 50 µL 1X PBS to all wells. Immediately remove PBS by inversion.
3. Using an inverted microscope, inspect all of the wells used in the 96-well plate and record the visual observations using the scores in **Table 13-1**.

Table 13-1 Visual Observation Scoring

Viability Score	Brief Description[1]
1	Normal Cell Morphology and Cell Density
2	Altered Cell Morphology and/or Small Gaps between Cells
3	Altered Cell Morphology and/or Large Gaps between Cells
4	Few (or no) Visible Cells
1P	Score of 1 with Precipitate
2P	Score of 2 with Precipitate
3P	Score of 3 with Precipitate
4P	Score of 4 with Precipitate
5P	Unable to View Cells Due to Precipitate

[1]Reference micrographs will be provided by NICEATM.

13.3 Lysis of Cells for LUMI-CELL® ER

1. Apply the reflective white backing tape to the bottom of the 96-well plate (this will increase the effectiveness of the luminometer).
2. Add 30µL 1X lysis reagent to the assay wells and place the 96-well plate on an orbital shaker for one minute.
3. Remove plate from shaker and measure luminescence (as described in **Section 11.5**).

13.4 CellTiter-Glo® Assessment of Cell Viability

When considered necessary, a quantitative evaluation of cell viability will be performed with the Promega CellTiter-Glo® assay system. CellTiter-Glo® uses luminescence as an indicator of the number of cells per plate and therefore must be conducted in parallel with the LUMI-CELL® ER test method (i.e., both test methods cannot be conducted on the same plate).

1. Dose and incubate cells under the same conditions as for LUMI-CELL® ER.
2. Remove plates from incubator and discard the medium by inverting the plate onto blotter paper. Gently tap plate against the bench surface to remove residual liquid trapped in the wells.

3. Use a repeat pipetter to add 50 µL 1X PBS to all assay wells. Immediately remove PBS by inversion.
4. Examine all wells used under an inverted microscope. Make notes of any well with codes described in **Table 13-1**.
5. Place white backing tape on the bottom of the 96-well plate.
6. Add 100 µL estrogen-free DMEM to each well containing cells.
7. Add 100 µL CellTiter-Glo® reagent to each well containing cells.
8. Place plate on an orbital shaker for 1 minute to induce cell lysis.
9. Incubate (see **Section 9.0** for details) for 10 min.
10. Measure luminescence promptly as in **Section 13.5**. Do *not* add luciferase reagent to CellTiter-Glo® plates.

13.5 Measurement of Luminescence

Luminescence is measured in the range of 300 to 650 nm, using an injecting luminometer and with software that controls the injection volume and measurement interval. Light emission from each well is expressed as relative light units (RLU) per well. The luminometer output is saved as raw data in an Excel® spread sheet. A hard copy of the luminometer raw data should be signed, dated and stored in the study notebook.

13.6 Data Analysis

LUMI-CELL® ER uses an Excel® spreadsheet to collect and adjust the RLU values obtained from the luminometer and a GraphPad PRISM® template to analyze and graph data. Plate reduction is calculated using unadjusted RLU values.

The Excel® spreadsheet subtracts background luminescence (average DMSO solvent control RLU value) from test substance, reference standard and control RLU values. Test substance, reference standard, and control RLU values are then adjusted relative to the highest Ral/E2 reference standard RLU value, which is set to 10,000. After adjustment, values are transferred to GraphPad PRISM® for data analysis and graphing.

13.6.1 Correction and Adjustment of Luminometer Data

The following steps describe the procedures required to populate the Excel® spreadsheet that has been configured to collect and adjust the RLU values obtained from the luminometer.

1. Open the raw data file and the corresponding experimental Excel® spreadsheet from **Section 13.1.1**.

2. Copy the raw data using the Excel® copy function, then paste the copied data into cell C22 of the "RAW DATA" tab in the experimental Excel® spreadsheet using the Paste Special – Values command. This position corresponds to position B2 in the table labeled Table 1 in this tab.
3. Examine the DMSO data in Table 1 of the Excel® spreadsheet to determine whether there are any potential outliers. See **Section 13.6.2** for further explanation of outlier determinations.
4. If an outlier is identified, perform the following steps to remove the outlier from calculations:
    - correct the equation used to calculate DMSO background in Table 1, e.g., if outlier is located in cell G24, adjust the calculation in cell H42 to read =AVERAGE(F24.H24,I24)
    - then correct the equation used to calculate the average DMSO value in Table 2, e.g., following the above example, adjust cell M44 to read =AVERAGE(F36,H36,I36)
    - then correct the equation used to calculate the standard deviation of the DMSO value in Table 2, e.g., following the above example, adjust cell M45 to read =STDEV(F36,H36,I36)
5. Excel® will automatically subtract the background (the average DMSO control value) from all of the RLU values in Table 1 and populate Table 2 with these adjusted values.
6. To calculate plate reduction, identify the cell containing the Ral/E2 replicate that has the lowest RLU value and the cell containing the RLU value for the same concentration in the corresponding Ral/E2 replicate (e.g., if the lowest RLU value for Ral/E2 is located in cell E23, the corresponding cell would be E22).
7. Identify the cell containing the Ral/E2 replicate that has the highest RLU value and the cell containing the RLU value for the same concentration in the corresponding Ral/E2 replicate
8. Click into cell D16 and enter the cell numbers from **Section 13.6.1 step 6** into the numerator and the cell numbers from **step 7** into the denominator.
9. Click on the "ER Antagonist Report" tab.
10. The data for the Ral/E2 reference standard, DMSO, E2, and Flavone/E2 replicates populate the left portion (columns A-F) of the spreadsheet. The data is automatically placed into an Excel® graph.

11. To set the highest RLU value for the reference standard to 10,000 RLU, go to cell D2 of "ER Antagonist Report" tab and check the formula contained within that cell. The divisor should be the cell number of the cell containing the highest averaged Ral/E2 RLU value (column E).
12. Forecast the EC50 value using the formula (FORECAST(x,known_y's,known_x's), where x = the data point for which you wish to predict a value [i.e., the median RLU], known y's = the three RLU values that constitute the middle of the linear portion of the concentration-response curve, and known x's = the concentrations corresponding to the known y's).
13. Copy the data into GraphPad PRISM® for graphing and analysis as indicated in the NICEATM PRISM® users guide.

13.6.2 Determination of Outliers

The Study Director will use good statistical judgment for determining "unusable" wells that will be excluded from the data analysis and will provide an explanation in the study notebook for any excluded data. This judgment for data acceptance will include Q test analysis.

The formula for the Q test is:

$$\frac{Outlier - Nearest\ Neighbor}{Range\ (Highest - Lowest)}$$

where the outlier is the value proposed for exclusion, the nearest neighbor is the value closest to the outlier, and the range is the range of the three values (Q values for samples sizes from 3 to 10 are provided in Table 13-2). For example, if the value of this ratio is greater than 0.94 (the Q value for the 90% confidence interval for a sample size of three) or 0.76 (the Q value for the 90% confidence interval for a sample size of four), the outlier may be excluded from data analysis.

Table 13-2 Q Test Values

Number Of Observations	Q Value
2	-
3	0.94
4	0.76
5	0.64
6	0.56
7	0.51
8	0.47
9	0.44
10	0.41

For E2 reference standard replicates (sample size of two), any adjusted RLU value for a replicate at a given concentration of E2 is considered and outlier if its value is more than 20% above or below the adjusted RLU value for that concentration in the historical database.

13.6.3 Acceptance Criteria

Acceptance or rejection of a test is based on evaluation of reference standard and control results from each experiment conducted on a 96-well plate. Results are compared to quality controls (QC) for these parameters derived from the historical database, which are summarized below.

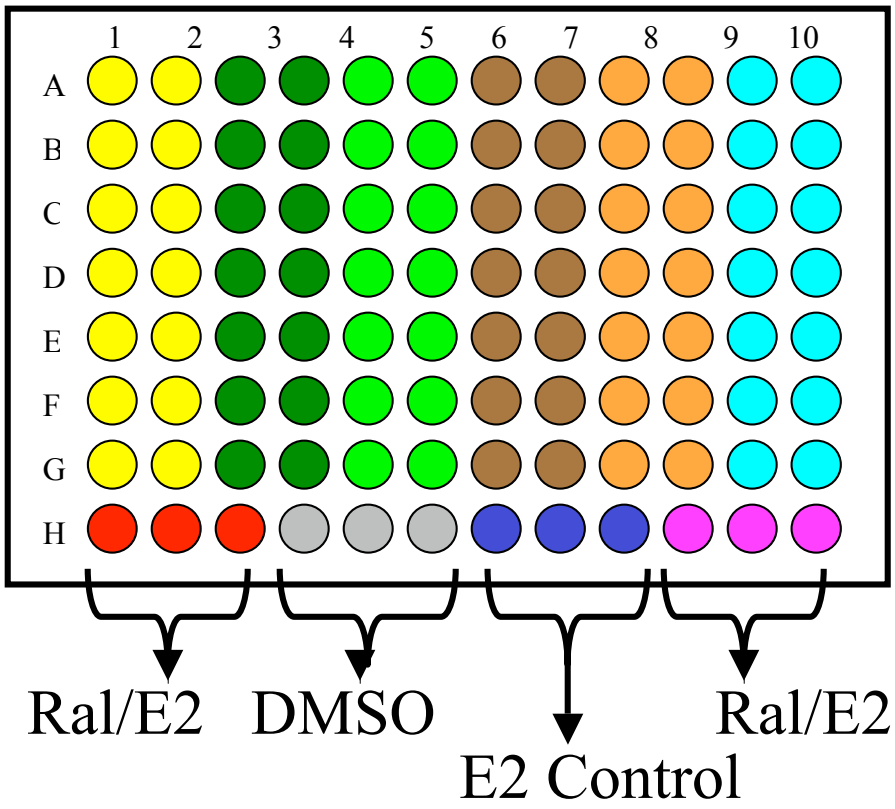
- Reduction: Plate reduction, as measured by dividing the averaged highest Ral/E2 reference standard RLU value by the averaged lowest Ral/E2 reference standard RLU value, must be greater than three fold.
- Reference standard results: Calculated Ral/E2 reference standard IC_{50} values must be within 2.5 times the standard deviation of the historical database IC_{50} mean value.
- Solvent control results: DMSO control RLU values must be within 2.5 times the standard deviation of the historical solvent control mean RLU value.
- E2 control results: E2 control RLU values must be within 2.5 times the standard deviation of the historical E2 control mean RLU value.
- Positive control results: Flavone/E2 control RLU values must be within 2.5 times the standard deviation of the historical database flavone/E2 control mean RLU value.

An experiment that fails any single acceptance criterion will be discarded and repeated.

14.0 RANGE FINDER TESTING

Antagonist range finding for coded substances consists of six-point, logarithmic serial dilutions tested in duplicate wells of the 96-well plate. **Figure 14-1** contains a template for the plate layout used in antagonist range finder testing.

862 **Figure 14-1 Antagonist Range Finder Test Plate Layout**



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- **Three Point Ral/E2 Reference Standard – Replicate 1**
- **Three Point Ral/E2 Reference Standard – Replicate 2**
- **DMSO Control (1% v/v)**
- **E2 Control (2.5 x 10^{-5} µg/mL)**
- **Range Finder for Sample #1**
- **Range Finder for Sample #2**
- **Range Finder for Sample #3**
- **Range Finder for Sample #4**
- **Range Finder for Sample #5**
- **Range Finder for Sample #6**

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865

Evaluate whether range finder experiments have met the acceptance criteria (see **Section 13.6.3**) graph the data as described in the NICEATM PRISM® users guide.

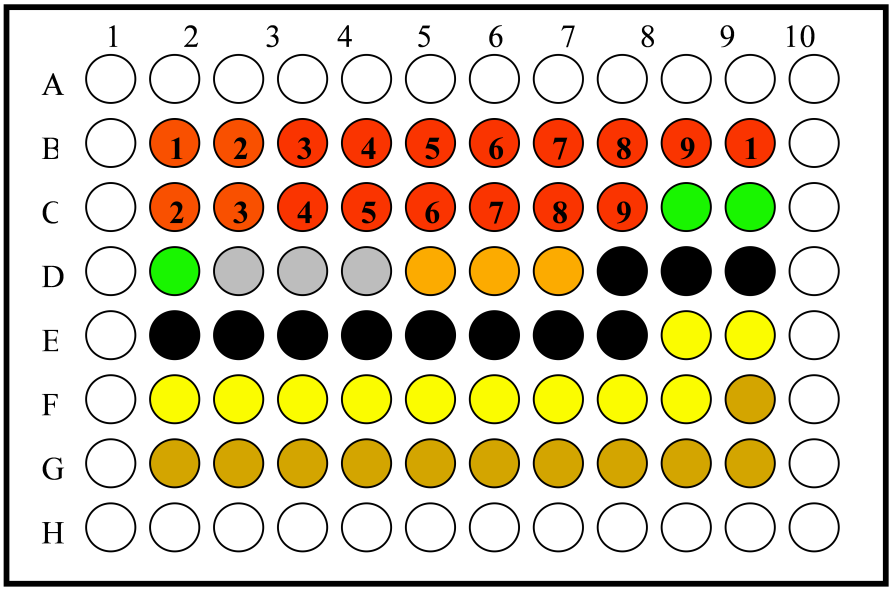
To determine starting concentrations for comprehensive testing use the following criteria:

- If there are no points on the test substance concentration curve that are less than the mean value of the E2 control minus three times the standard deviation from that mean, the highest concentration used in comprehensive testing is the limit dose or the maximum soluble dose.
- If there are points on the test substance concentration curve that are below the mean value of the E2 standard control minus three times the standard deviation from that mean, select a concentration that is a single log dilution higher than the concentration giving the lowest adjusted RLU value in the range finder and use that as the highest concentration for comprehensive testing.
- If a substance exhibits a biphasic concentration curve, the range finder experiment should be repeated unless the proposed concentration range for the comprehensive studies will include all concentrations of the biphasic region in the range finding study. If the range finder experiment is repeated and the substance still exhibits a biphasic concentration curve, comprehensive testing must be conducted on the peak of the biphasic curve at the lowest test substance concentration. If the substance is negative at this lowest concentration, then test at the higher concentration. For either peak of the concentration curve, select a concentration that is a single log dilution higher than the concentration giving the lowest adjusted RLU value in the range finder and use that as the highest concentration for comprehensive testing.

15.0 COMPREHENSIVE TESTING

Antagonist comprehensive testing for coded substances consists of 11-point, double serial dilutions, with each concentration tested in triplicate wells of the 96-well plate. **Figure 15-1** contains a template for the plate layout to be used in antagonist comprehensive testing.

Figure 15-1 Antagonist Comprehensive Test Plate Layout



- 9 point Ral/E2 Reference Standard Dose Response Curve

- Flavone Control (25 µg/mL)

- DMSO Control (1%)

- E2 Control (2.5 x 10^{-5} µg /mL)

- Comprehensive Dose Response Sample #1, Replicate #1

- Comprehensive Dose Response Sample #1, Replicate #2

- Comprehensive Dose Response Sample #1, Replicate #3

- Media only wells, not used for assay

Evaluate whether comprehensive experiments have met acceptance criteria (see **Section 13.6.3**) and graph the data as described in the NICEATM PRISM® users guide.

- If the substance has been tested up to the limit dose or the maximum soluble dose without causing a significant decrease in cell viability, and there are no points on the concentration curve that are below the line indicating the mean minus three times the standard deviation of the E2 control, the substance is considered negative for antagonism.
- If the substance has been tested up to the limit dose and there are points on the concentration curve that are below the line indicating the mean minus three times the standard deviation of the E2 control, but cell viability, as measured by

CellTiter-Glo® falls below 80%, or a visual inspection score of 2 or greater, at all points falling below the E2 line, the substance is considered negative for antagonism.

- If there are points on the test substance concentration curve that are below the line indicating the mean minus three times the standard deviation of the E2 control that do not cause a decrease in cell viability below 80% as measured by CellTiter-Glo®, or a visual inspection score of 2 or greater, the substance is positive for antagonism.
    - Points in the test substance concentration curve that cause a decrease in cell viability to below 80% as measured by CellTiter-Glo® or a visual inspection score of 2 or greater, are not included in data analyses.

16.0 USE OF THE HISTORICAL DATABASE TO GENERATE QC CHARTS

The historical database is maintained in order to ensure that the test method is functioning properly. The historical database is maintained as an Excel® spreadsheet that is separate from the spreadsheets used to report the data for individual experiments. The controls used to develop the historical database are used as one of the criteria for determining a valid test.

Results collected during Phase I will be compared to historical control data established during the LUMI-CELL® ER Protocol Standardization Study. Reference standard and control data collected during Phase I will be used to compile the initial historical database. Reference standard and control data collected during Phase IIa will be added to the historical database compiled in Phase I and this combined historical database will be used to establish acceptance criteria for Phase II. Reference standard and control data collected during Phase IIb will be added to the historical database compiled in Phases I and IIa and this combined historical database will be used to establish acceptance criteria for Phases III and IV.

16.1 LUMI-CELL® ER Antagonist QC Charts

1. Open the Excel® spreadsheet labeled LUMIAntagonistQC.
2. Save this sheet under a new name, adding the laboratory designator to the file name (e.g., for Laboratory A, the new name would be ALUMIAntagonistQC).

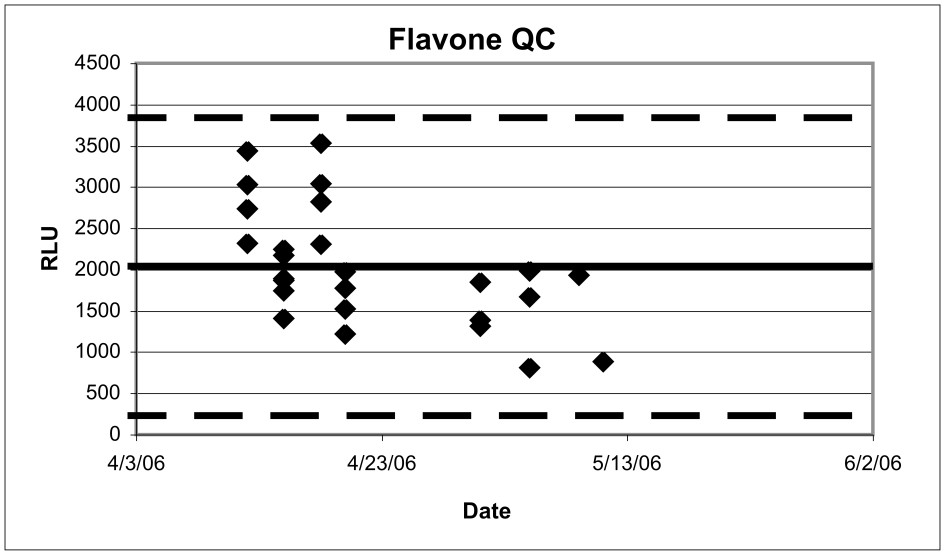
16.1.1 Flavone/E2

1. Open Excel® spreadsheet XDSLUMIAntQC.
2. Click on flavone tab and enter the date, plate number (name), and the average 1.56×10^{-3} µg/mL RLU value for ral/E2 (data located in column F on the "List" tab of the antagonist report file).

3. Enter the three values for flavone/E2 into column D.
4. The mean and 2.5 times the standard deviation plus (and minus) the mean are calculated automatically.
5. Check the Scatter Charts tab to see if the average value for flavone/E2 falls within 2.5 times the standard deviation (e.g., **Figure 16-1**) of the historical mean. If the mean flavone/E2 value falls within the 2.5 times the standard deviation area, it passes QC. Otherwise it fails QC and the experiment must be repeated.

Acceptance or rejection of the flavone/E2 control data is based on whether the data for a given experiment falls within 2.5 times the standard deviation from the historical mean RLU value.

Figure 16-1 Example Scatter Chart of the Flavone/E2 Control QC[1,2,3]



[1]Each point represents a single experiment.
[2]The solid line represents the historical mean RLU value for the flavone control.
[3]The two dashed lines represent the historical mean RLU value for the flavone control plus and minus 2.5 times the standard deviation from the historical mean.

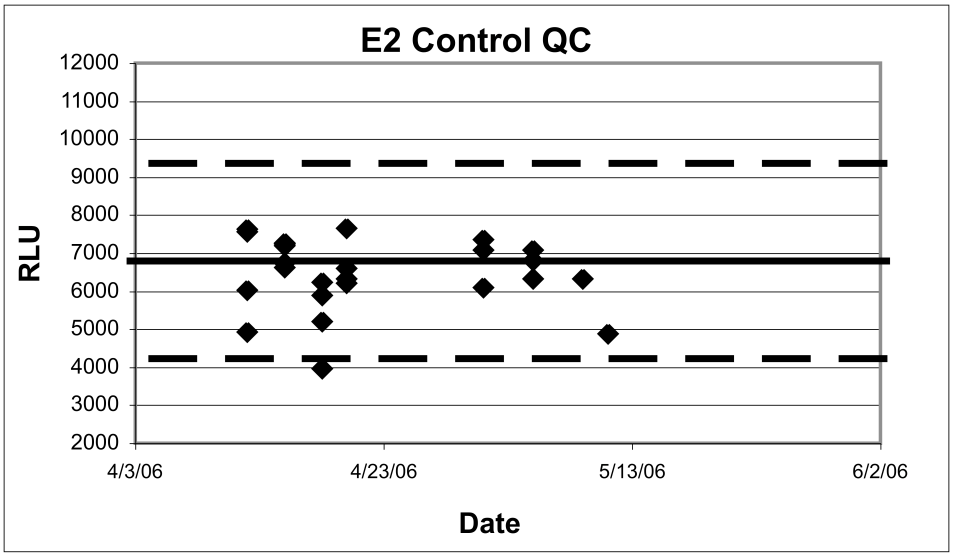
16.1.2 E2 Control

1. Click on the E2 control tab. The date, study name, and 1.56 x 10^{-3} μg/mL ral/E2 data should be populated in the appropriate position.
2. Enter the values for the E2 control into column D.
3. The mean and 2.5 times the standard deviation plus (and minus) the mean are calculated automatically.
4. Check the scatter charts tab to see if the average value for the E2 control falls within the 2.5 times the standard deviation (**Figure 16-2**) from the historical

mean. If the value falls within the 2.5 times the standard deviation area, the E2 control passes QC. Otherwise it fails QC and the study must be repeated.

Acceptance or rejection of the E2 control data is based on whether the data for a given experiment falls within 2.5 times the standard deviation from the historical mean RLU value.

Figure 16-2 Example Scatter Chart of the E2 Control QC[1,2,3]



[1]Each point represents a single experiment.

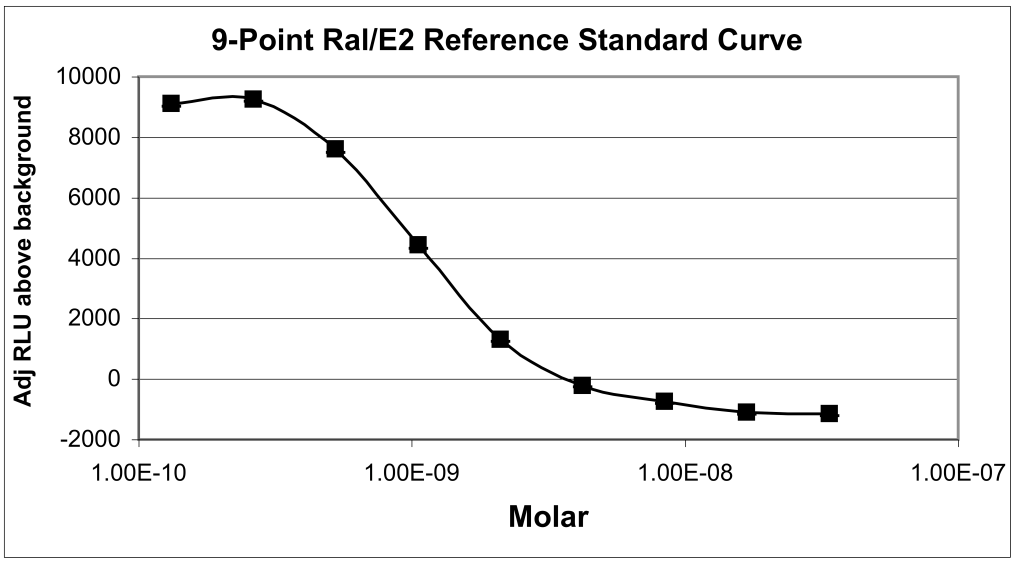
[2]The solid line represents the historical mean RLU value for the E2 control.

[3]The two dashed lines represent the historical mean RLU value for the E2 control plus and minus 2.5 times the standard deviation from the historical mean.

16.1.3 9-Point Ral/E2 Reference Standard QC

1. Enter the experiment date and name, and copy and paste the adjusted RLU values for Ral/E2 into the appropriate slots on the tab labeled Ral E2 Standard Curve.
2. The Ral/E2 standard curve is automatically graphed to ensure a normal sigmoidal shape (see **Figure 16-3** for an example curve).

977 **Figure 16-3 Example Figure of a Sigmoidal Ral/E2 Concentration Response Curve[1]**



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979 [1]The points on the line represent the averaged Ral/E2 values for a single experiment.

980 16.1.4 IC_{50} Tracking Data

981 1. Enter the date and plate ID into the first two columns of the IC_{50} Tracking Data
982 tab.

983 2. Link the EC_{50} data from the 9-point Ral/E2 Curve QC tab to the column to the
984 right of the plate information.

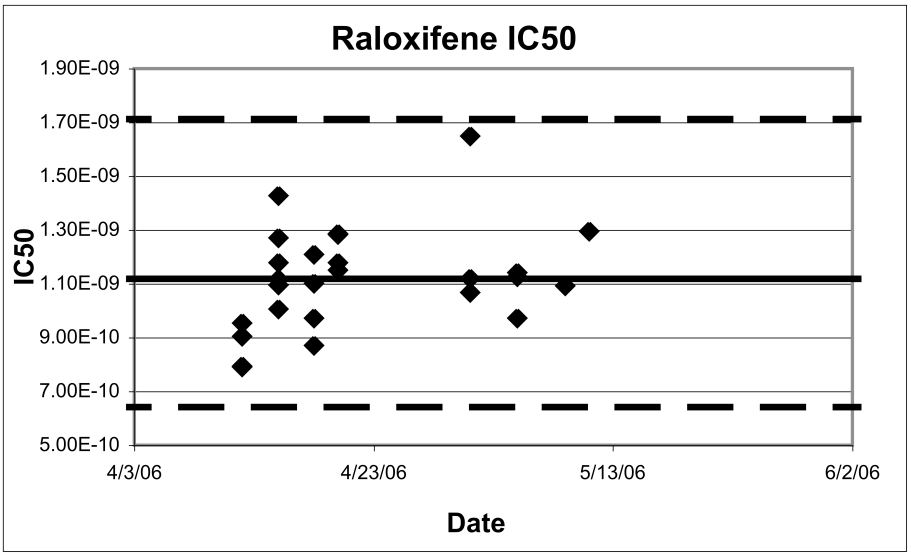
985 3. Column E calculates the percent deviation from the historical database IC_{50} value.

986 4. The mean and 2.5 times the standard deviation plus (and minus) the mean for the
987 IC_{50} deviation are calculated automatically.

988 5. Check the Scatter Charts tab to see whether the experimental IC_{50} value falls
989 within the 2.5 times the standard deviation (**Figure 16-4**). If the value falls within
990 the 2.5 times the standard deviation area, it passes QC. If the value does not fall
991 within the 2.5 times the standard deviation, it fails QC and the experiment must be
992 repeated.

993

Figure 16-4 Example Scatter Chart of the Ral/E2 IC_{50} Control QC[1,2,3]



[1]Each point represents a single experiment.

[2]The solid line represents the historical mean RLU value for the Ral/E2 EC_{50}.

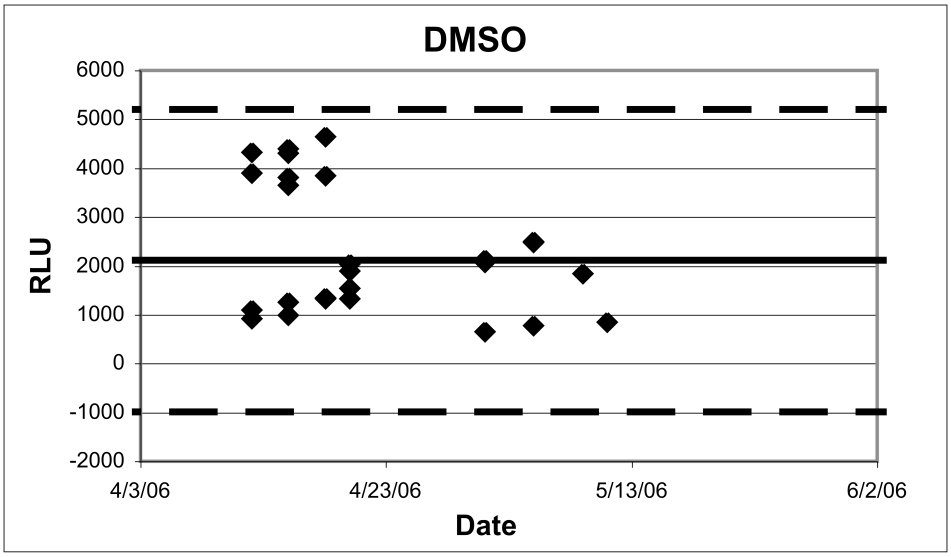
[3]The two dashed lines represent the historical mean RLU value for the Ral/E2 control plus and minus 2.5 times the standard deviation from the historical mean.

Acceptance or rejection of Ral/E2 IC_{50} data is based on whether the data falls within 2.5 times the standard deviation from the mean for the historical Ral/E2 IC_{50} RLU value.

16.1.5 DMSO

1. The date and experiment name should populate automatically
2. Enter all of the DMSO values from Table 1 on the "Raw Data" tab on the Excel® spreadsheet which passed the outlier test, into the areas marked DMSO 1, DMSO 2, DMSO 3, and DMSO 4.
3. The average RLU value for DMSO is then calculated under the "mean" column.
4. The mean and 2.5 times the standard deviation plus (and minus) the mean for the DMSO deviation are calculated automatically.
5. Check the Scatter Charts tab to see whether the average value for DMSO falls within 2.5 times the standard deviation (**Figure 16-5**) from the mean. If the value falls within the 2.5 times the standard deviation area, the DMSO passes QC. If the value does not fall within the 2.5 times the standard deviation, it fails QC and the experiment must be repeated..

Figure 16-5 Example Scatter Chart of the DMSO Control QC[1,2,3]



[1]Each point represents a single experiment.
[2]The solid line represents the historical mean RLU value for the DMSO control.
[3]The two dashed lines represent the historical mean RLU value for the DMSO control plus and minus 2.5 times the standard deviation from the historical mean.

Acceptance or rejection of the DMSO control data is based on whether the data for a given experiment falls within 2.5 times the standard deviation from the historical mean RLU value.

16.1.6 Reduction

Reduction is calculated by dividing the highest RLU value for each of the Ral/E2 standards by the lowest Ral/E2 RLU value. To calculate reduction, follow the steps below:

Enter the reduction value from the "Raw Data" tab on the Excel® spreadsheet. If the value is greater than or equal to 3, the experiment passed QC. An induction value of less than 3 fails induction QC and the experiment must be repeated.

17.0 QUALITY TESTING OF MATERIALS

All information pertaining to the preparation and testing of media, media supplements, and other materials should be recorded in the Study Notebook.

17.1 Tissue Culture Media

Each lot of tissue culture medium must be tested in a single growth flask of cells before use in ongoing tissue culture or experimentation (**note:** each bottle within a given lot of Charcoal/Dextran treated FBS must be tested separately).

1. Every new lot of media (RPMI and DMEM) and media components (FBS, Charcoal/Dextran treated FBS, and L-glutamine) must first be tested on the LUMI-CELL® ER assay prior to being used in any GLP acceptable assays.
2. Add 4 µL of DMSO (previously tested) into four separate 13 mm tubes.
3. Add 400 µL media (to be tested) to 13 mm tube.
4. Dose an experimental plate as in **Section 12.0,** treating the media being tested as a test substance.
5. Analyze 96-well plate as described in **Section 12.0,** comparing the data from the DMSO controls made using previously tested tissue culture media to the new media being tested.
6. Use the QC charts to determine if the new media with DMSO lies within 2.5 standard deviation of the mean for the media. If the RLU values for the new media with DMSO are within 2.5 standard deviation of the mean for the historical data on DMSO, the new lot of media is acceptable. If the RLU values for the new media with DMSO are not within 2.5 standard deviation of the mean for the historical data the new lot may not be used in the assay.
7. Note date and lot number in study notebook.
8. If the new bottle passes the QC as described in **Section 15.1 step 6**, apply the media to a single flask cells and observe the cells growth and morphology over the following 2 to 3 days. If there is no change in growth or morphology, the new media is acceptable for use.

17.2 G418

1. New lots of G418 must first be tested on the LUMI-CELL® ER assay prior to being used in any GLP acceptable assays.
2. Add 220 µL of G418 (previously tested) to a single flask containing cells growing in RPMI.
3. Add 220 µL of G418 (to be tested) to a different flask containing cells growing in RPMI.
4. Observe cellular growth and morphology in both tissue culture flasks over a 48 to 72 hour period. If there are no differences in observed growth rate and morphology between the two flasks, the new G418 lot is acceptable.
5. If cellular growth is decreased, or the cells exhibit abnormal morphology, the new lot of G418 is not acceptable.
6. Note date and lot number in study book.

17.3 DMSO

1. Every new bottle of DMSO must be tested on the LUMI-CELL® ER assay prior to use in any GLP acceptable assays.
2. Add 4 µL of DMSO (to be tested) into four separate 13 mm tubes.
3. Add 400 µL media (previously tested) the same tubes.
4. Dose an experimental plate as in **Section 15.0,** treating the media being tested as a test substance.
5. Analyze 96-well plate as described in **Section 15.0,** comparing the data from the DMSO controls made using previously tested tissue culture media to the new media being tested.
6. Use the QC charts to determine if the new media with DMSO lies within 2.5 standard deviation of the mean for the media. If the RLU values for the new media with DMSO are within 2.5 standard deviation of the mean for the historical data on DMSO, the new lot of media is acceptable. If the RLU values for the new media with DMSO are not within 2.5 standard deviation of the mean for the historical data the new lot may not be used in the assay.
7. Use the QC charts to determine if the new DMSO is within 2.5 standard deviation of the mean for DMSO background. If the RLU for the new DMSO is within 2.5 standard deviation of the mean for the historical data on DMSO, then the new bottle of DMSO is acceptable; otherwise the new bottle may not be used in the assay.
8. Note the date, lot number, and bottle number in study book.
9. If no DMSO has been previously tested, test several bottles as described in **Section 15.3**, and determine whether any of the bottles of DMSO have a higher average RLU than the other bottle(s) tested. Use the DMSO with the lowest average RLU for official experiments.

17.4 Plastic Tissue Culture Materials

1. Grow one set of cells, plate them for experiments on plastic ware from the new lot and one set of cells in the plastic ware from a previous lot, and dose them with E2 reference standard and controls.
2. Perform the LUMI-CELL® ER experiment with both sets of cells.
3. If all of the analysis falls within acceptable QC criteria, then the new manufacturer's products may be used.

18.0 REFERENCES

ICCVAM. 2001. Guidance Document on Using *In Vitro* Data to Estimate *In Vivo* Starting Doses for Acute Toxicity. NIH Pub. No. 01-4500. Research Triangle Park, NC: National Institute of Environmental Health Sciences. Available: http://iccvam.niehs.nih.gov/methods/invidocs/guidance/iv_guide.pdf [accessed 31 August 2006]